APOLLO-SOYUZ TEST PROJECT

OPERATIONS HANDBOOK COMMAND/SERVICE/DOCKING MODULES

CSM 119/DM 1

OPERATIONAL PROCEDURES REFERENCE ISSUE

PREPARED BY
ROCKWELL INTERNATIONAL
UNDER DIRECTION
OF
CREW TRAINING AND PROCEDURES DIVISION

CONTRACT NAS9-13100
SD 72-CS-0040
DRL LINE ITEM NO. 9

National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas

SD 74-CS-0026

15 JULY 1974

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF CG54-74M-175

August 26, 1974

MEMORANDUM

TO: JM3/Chief, Printing Management Office

FROM: CG5/Chief, Flight Planning Branch

SUBJECT: ASTP Operations Handbook, Command/Service Module, CSM 119, Volume II, JSC 09092

Subject handbook is currently in printshop for reproduction. The number of printed copies versus distribution requirements (250 versus 228) leaves 22 copies to be delivered to this office. The attachment defines the required distribution and should be inserted behind the cover sheet.

It is requested that the negatives be returned to Rockwell International at the following address:

Rockwell International Corporation
Space Division
12214 Lakewood Boulevard
Downey, California 90241
Attn: Data Management
D/096 - Bldg. 4
S100 - E37

Thomas W. Holloway

Enclosure

CG54/RAMoses:jt:8/26/74:2541

JSC-09092

APOLLO-SOYUZ TEST PROJECT
OPERATION HANDBOOK

COMMAND/SERVICE/DOCKING MODULES
SYSTEMS OPERATING PROCEDURES
CSM 119/DM 1

APPROVED

C.W. Helms, Chief Program Engineer
CSM Programs, Space Division
Rockwell International Corporation

Contract NAS9-13100

Prepared under direction
of

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
CREW TRAINING & PROCEDURES DIVISION

APPROVED

T.W. Holloway, Acting Chief
Data Management Office

15 July 1974
Document Issue Date

HANDBOOK CHANGE CONTROL

The June 1974 publication of this handbook shall be a complete handbook reissue, identified on the cover as a REFERENCE publication. Continuity from this reference issue to final publication dated October 1, 1974, shall be documented by applicable "Crew Procedures Change Request" - MSC Form 482B. Systems operating procedures which cannot be adequately defined because of lack of hardware definition will be identified as TBD. No procedural "TBD" will appear in the final publication providing the hardware configuration is adequate to define operating procedures. All NASA-approved change proposals shall be included in the final published handbook, allowing two weeks cutoff prior to publication date for copy and edit functions. There are two types of changes: RECORD CHANGE and CONTROL CHANGE.

RECORD CHANGE: A record change may be incorporated by the contractor without formal coordination and approval by NASA. Such changes shall consist of non-procedural changes to the format or Remarks column, corrections of an editorial nature, and implementation of specific changes directed by CCP actions where interpretation of procedural intent is clear. Supporting information as appropriate shall be included on Form 482B in the space marked "Reason for Change." Informational copies of all record changes will be directed to JSC Crew Training and Procedures Division (CT&PD), Data Management Office (DMO), Mail Code CG121, on MSC Form 482B.

CONTROL CHANGE: A control change originates on MSC Form 482B as a handbook change proposal, and includes the technical rationale in support of the proposed change, applicable references, etc. The scope of a change proposal shall be of a small enough magnitude to properly lend itself to the intent of change control. Each change submittal shall clearly indicate CSM-111 or CSM-110 effectivity. The initiator shall direct the original copy of Form 482B to CT&PD (DMO), where a control number and suspense date will be assigned (approximately two weeks); the change proposal will be reproduced and distributed to affected organizations for technical review and response within five working days of receipt of the proposed change. A "no response" philosophy is adopted for individual JSC organizations. No reply to CT&PD (DMO) prior to change suspense date indicates change concurrence by the reviewing organization; however Rockwell International shall give positive concurrence or nonconcurrence to CT&PD (DMO) for each change prior to expiration of change suspense date. All change proposals originating within MSFC or contractor organizations must be approved by that originating organization prior to submittal to CT&PD (DMO). During the review cycle (prior to expiration of suspense date), CT&PD (DMO) may modify the change proposal by an "A" revision (new data, change error, effectivity change, etc.), assign a new suspense date and recycle review copies of the modified change. At the expiration of the suspense date, CT&PD ASTP Flight Data Manager (FDM) shall approve or disapprove each change proposal, contingent upon review results. Change approval by NASA is direction to the contractor to incorporate those FDM-approved changes into the final published handbook update -- allowing two weeks cutoff prior to publication date for copy and edit functions.

...cont

Every disapproval by CT&FD will be supported by the technical rationale for disapproval, and such rationale will be directed back to the change initiator. If the disapproval is not applicable to the entire change proposal, the change initiator must resubmit the valid portions (if any) of the disapproved change as a new change proposal. If the disapproval by CT&FD (FDF) appears erroneous or unjustified by the change initiator, he may petition the CPCB for disposition reversal. NASA approval and release of guidance system program changes for specific vehicle effectivities shall constitute adequate contractor authorization to revise applicable operating procedures accordingly, without additional change control review and approval.

All procedures emphasis and change control subsequent to the October 1, 1974 final Operations Handbook issue shall shift to the ASTP Flight Data File (FDF) and each procedures change (482B) shall be addressed to appropriate FDF article(s). Refer to the Crew Procedures Management Plan (JSC 08466) for change control and FDF development (Crew Procedures Control Board) commencing at launch minus 9 months.

The final published handbook, dated October 1, 1974, shall identify all changes incorporated by control and record change numbers and shall provide change bar identifiers for the technical changes in the text margin. A MSC Form 482B "CREW PROCEDURES CHANGE REQUEST" is included within this handbook for user convenience -- and may be reproduced for multiple change submittals.

CREW PROCEDURES CHANGE REQUEST

[illegible]	ORGANIZATION & PHONE #	INITIATORS CPCB MEMBER SIGNATURE	DATE SUBMITTED

DOCUMENT AFFECTED

[illegible]	BASIC ORB DATE	PAGE NUMBER	MISSION	CONTROL NUMBER

DETAIL CHANGE IN EXACT WORDING:

TECHNICAL RATIONALE:

OTHER DATA AFFECTED:

CPD DISPOSITION

CHANGE CLASSIFICATION	BOOK MANAGER APPROVAL	BRANCH CHIEF APPROVAL	FLIGHT DATA MANAGER APPROVAL	ACTIVITY ELEMENT
FORMAT ☐	SIGNATURE/DATE	SIGNATURE/DATE	SIGNATURE/DATE	COMPLEX ACTIVITY
TECHNICAL RECORD ☐	DISAPPROVED ☐	DISAPPROVED ☐	DISAPPROVED ☐	
TECHNICAL INTERIM ☐	IMPLEMENTATION: TRAINING SUPPORT ☐ ROUTINE ☐			DATE: NOT EARLIER THAN ____
TECHNICAL HOLD ☐	MOPS ☐ CPDS ☐ FDF ☐ OH ☐ OTHER ____			NO LATER THAN ____

CPCB DISPOSITION

CPCB SCHEDULE DATE	FCOD APPROVAL SIGNATURE	DISAPPROVED ☐	DATE

MSC FORM 482 B (REV JUNE 72)

NASA-MSC

CHANGE REQUEST INSTRUCTIONS

GENERAL - To effect complete coordination and evaluation, it is necessary to reproduce and distribute copies of each change request. In order to assure all recipients receive legible copies, please print all entries and prepare mark-ups using black ink.

INITIATOR NAME/ADDRESS/PHONE - Use address and phone number where requestor can be reached if different from official address.

INITIATORS CPCB MEMBER SIGNATURE - Must be signed off by the CPCB member of the initiators organization before the change request will be processed by the Flight Data Manager.

DATE - Indicate the date (month, day, year) the change request is submitted.

TITLE - Use only the official title as shown on the cover of the FDF article.

BASIC/CHG DATE - Indicate the latest date of publication or change to the affected article.

PAGE NUMBER - List all pages affected by the change.

MISSION - Denote mission applicability; if valid for all missions - "All."

CONTROL NUMBER - Leave blank. This number will be assigned by the Data Management Control Office.

DETAIL CHANGE IN EXACT WORDING - Self-explanatory.

TECHNICAL RATIONALE - Self-explanatory.

OTHER DATA AFFECTED - Indicate any other data articles, documents or data elements affected by the change.

The remainder of the form will be completed by the Book Manager and/or Flight Data Manager and the Data Management Control Office.

U S GOVERNMENT PRINTING OFFICE 1972 - 779 479/18

TABLE OF CONTENTS

STA/T STEP	PROCEDURE	PANEL	REMARKS
	1.0 BACKUP CREW PRELAUNCH CHECKS		
	Prelaunch procedures consist of operational and configuration checks performed by backup flight crew prior to ingress of prime crew. Procedures have been sequenced so they can be more easily compared with other prelaunch documents. In order to keep them closely aligned, redundant switch settings may appear in more than one area and GDC align procedures have been repeated wherever necessary. It is assumed that a complete prelaunch checkout, including loose gear stowage, has been performed by ground support personnel, prior to backup crew ingress into command module, and that all systems are in an active configuration as required at time of ingress. Spacecraft suit circuit shall have been purged and oxygen content verified to be 95% minimum. Backup crew will utilize facility headsets until service structure is clear of vehicle, as there will be no VHF AM or S BAND transmission until that time. Refer to Appendix A for cabin switch/control position prior to backup crew cabin ingress.		
	1.1 C&WS STATUS CHECK		
CP	C/W NORM - NORM	2	
	C/W CSM - CSM		
	C/W PWR - 2 [pause at off (ctr) at least 1 sec]		Excessive switching speed will cause temporary loss of both power supplies, and alarm reset capability.
ALL	MASTER ALARM pb/lt (3) - on, push	1,3,122	
CP	C/W PWR - 1 [pause at off (ctr) at least 1 sec]	2	Excessive switching speed will cause temporary loss of both power supplies, and alarm reset capability.
ALL	MASTER ALARM pb/lt (3) - on, push	1,3,122	
CP	C/W LAMP TEST - 1 (hold)	2	1 position is momentary.
AC	MASTER ALARM pb/lt - on	1	
CP	lh C/W lt (18) - on	2	
	C/W NORM - BOOST		
AC	MASTER ALARM pb/lt - out	1	
CP	C/W NORM - NORM	2	
AC	MASTER ALARM pb/lt - on	1	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		C/W LAMP TEST - 2 (hold)	2	2 position is momentary.
AC		MASTER ALARM pb/lt - out	1	
CP		lh C/W lt (18) - out	2	
DP		MASTER ALARM pb/lt - on	3	
CP		rh C/W lt (18) - on	2	
		C/W LAMP TEST - rel		
DP		MASTER ALARM pb/lt - out	3	
CP		rh C/W lt (17) - out	2	If C/W NORM switch not in ACK position, SUIT COMPR C/W light will remain on until compressor is activated.
		C/W NORM - ACK		SUIT COMPR C/W light will go out.
	1.2	EMS PRELAUNCH TESTS		
	1	Initial EMS Prep		
AC		EMS FUNC - OFF	1	
		CAUTION If SPS THRUST lt on, a ground exists on one or both ΔV THRUST circuits.		
		cb EMS (2) - close	8	
		Open EMS GTA cover	1	A 5/32-inch hex driver is required.
		GTA sw - on (up)		GTA switch is used during ground operations only. Setting switch on (up) allows EMS calibration for zero G condition. Switch must be set off (down) and door closed before flight.
		EMS MODE - STBY		

EMS PRELAUNCH TESTS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	2	EMS FUNC - ΔV (CW) Adj alphanumeric brightness (option) Wait 5 sec	1	
	3	GTA Null Adj EMS MODE - NORM Adj GTA null adj until ΔV/RNG least significant digit changes <1 per 10 sec		
	4	EMS FUNC - ΔV SET (CW) Slew ΔV ind to +1586.8		ΔV/EMS SET switch used both for slewing G-V scroll and for setting ΔV/RNG indicator. Slew speeds executed by ΔV/EMS SET switch are as follows:
	5	EMS FUNC - ΔV TEST (CW) SPS THRUST lt - on ΔV ind - decr (10 sec)		Light should be fully illuminated, indicating that both filaments are functioning.

	G-V Display Ft/Sec 1827 Ft/Sec = 1 In. of Scroll	ΔV RNG Indicator Ft/Sec or Nautical Miles
Slow (soft stop) INCR or DECR	30 ft/sec/sec = 0.0164 in./sec	0.25/sec
Fast (hard stop) INCR or DECR	480 ft/sec/sec = 0.263 in./sec	127.5/sec

For negative numbers ΔV/RNG indicator will display a minus sign. No sign will appear for positive numbers.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SPS THRUST lt - out (at ΔV -0.1 fps) ΔV ind - stops at -0.1 to -41.5 fps EMS MODE - STBY	1	
	6	EMS FUNC - EMS TEST 1 (CCW) (wait 5 sec)		Test 1 checks lower trip point of .05 G comparator.
		EMS MODE - NORM (wait 10 sec)		Ten seconds should be allowed to verify no malfunctions. No other light should come on before or after 10 seconds.
		.05 G lt - out SPS THRUST lt - out Lift vector dn lt - out Lift vector up lt - out RNG ind - 0.0 NM		
		Slew scroll until disp index superimposed upon notch at start of next self-test pattern		EMS scroll reverse slew capability is limited to one inch.
	7	EMS FUNC - EMS TEST 2 (CCW) .05G lt - on (all others out) Wait 10 sec All other EMS lights out		Test 2 checks upper trip point of .05 G comparator. No other light should come on before or after 10 seconds.
	8	EMS FUNC - EMS TEST 3 (CCW)		Test 3 checks corridor verification circuitry associated with lift vector down light (G <.2).
		.05 G lt - on		Light should be fully illuminated, indicating that both filaments are functioning.
		Lift vector dn lt - on (10 sec after .05 G lt) Set RNG ind to 58.0±0.0 NM		For negative numbers RNG indicator will display minus sign in most significant digit. No sign will appear for positive numbers.

EMS PRELAUNCH TESTS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	9	EMS FUNC - EMS TEST 4 (CCW) .05 G lt - on (all others out) G-V trace (during 10-sec period) within test pattern After 10 sec, G-V trace stops at lower right corner of test pattern RNG ind (during 10-sec period) counts toward zero After 10 sec, stops at 0.0±0.2 NM	1	Test 4 checks range-to-go integrator circuits, range-to-go indicator, G-servo circuits, and G-V plotter.
	10	EMS FUNC - EMS TEST 5 (CCW) .05 G lt - on Lift vector up lt - on (10 sec after .05 G lt) RNG ind - resets to 0.0 NM Scribe traces vert line ≈9 G to 0.28±0.1 G & stops (trace within test pattern)		Test 5 checks corridor verification circuitry associated with lift vector up light (G >.2). Enables slewing scroll to start of entry pattern. After scroll is set to <37K fps, it is not permissible to return EMS FUNC switch to EMS TEST 5 position (range integrator and scroll sync would be lost).
	11	Slew scroll until stylus is at 0.28 G tolerance step of ground test pattern 1 & verify ΔV instructions are visible		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	12	EMS FUNC - RNG SET (CCW) Scribe traces vert line from 0.28 G to 0.0±0.1 G & stops EMS MODE - STBY All lts - out	1	
	13	EMS FUNC - OFF (CCW)		
		WARNING GTA sw is for ground tests only & must be set off (down) & door closed for proper flt oper of EMS.		
		GTA sw - off (down) Close GTA cover		A 5/32-inch hex driver is required.
	1.3	GLYCOL LOOP CHECKS		
		Sec Gly Loop Check & Activation		Secondary glycol loop is checked and activated prior to EPE (MA014) experiment cool down.
CP		GLY TO RAD SEC vlv - NORM	377	
		ECS IND sel - SEC	2	
		SEC COOL PUMP - AC1		
		RAD SEC IN TEMP ind - 60°-97°F		
		RAD SEC OUT TEMP ind - 60°-70°F (pegged)		
		SEC GLY EVAP OUT TEMP ind - 60°-75°F (pegged)		
		SEC GLY EVAP STM PRESS ind - 0.25 psia (pegged)		
		SEC GLY DISCH PRESS ind - 39-52 psig		
		SEC ACCUM QTY ind - 30-60%		Range shown is for gauge. Comparable corrected range used for prelaunch redlines is 40-80%.
		SEC COOL PUMP - AC2		
		SEC GLY DISCH PRESS ind - 39-52 psig		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		ECS IND sel - PRIM	2	
		GLY TO RAD SEC vlv - BYP	377	
		EPE COOLING vlv - COOL (tool E)	165	German electrophoresis experiment (MA014). For stowage refer to NASA document (TBD).
		Prim Gly Loop Check		
		PRIM GLY DISCH PRESS ind - 39-52 psig	2	GSE flow must be temporarily interrupted (3 minutes maximum) for this check.
		PRIM ACCUM QTY ind - 25-50%		Range shown is for gauge. Comparable corrected range used for prelaunch redlines is 25-55%.
DP		GLY PUMPS - 1 AC1	4	
CP		PRIM GLY DISCH PRESS ind - 39-52 psig	2	
		RAD FLOW CONT PWR - PWR		
		RAD FLOW CONT AUTO - 2		
		ECS RAD tb - 2		2 indicates No. 2 flow proportioning valve controlling flow.
		RAD FLOW CONT AUTO - 1 until ECS RAD tb gray (≈20 sec) then AUTO		
		ECS RAD tb - gray		Gray indicates No. 1 flow proportioning valve controlling flow.
		RAD FLOW CONT PWR - off (ctr)		
AC		DIRECT O2 vlv - OPEN (CCW), adj for	7	
CP		O2 FLOW ind - 0.4±0.1 lb/hr	2	
	1.4	STANDBY INVERTER (NO. 3) CHECK		
DP		FC 2 & 3 PUMPS - AC1	5	To maintain continuous power to the FC pumps during inverter check.
		AC2 RSET - OFF	3	
		INV 3 - MNB		
		INV 2 AC2 - OFF		
		INV 3 AC2 - on (up)		Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when alternate inverter is connected to bus.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		AC2 RSET - RSET	3	RSET position is momentary. Positioning AC1 or 2 RSET switches to RSET and releasing ensures a MASTER ALARM light and tone. Positioning AC1 or 2 RSET switches to center will cause random activation of MASTER ALARM lights and tone.
CP,DP		MASTER ALARM pb/lt (2) - on (push)	3,122	SUIT COMPR C/W light will come on while MASTER ALARM pb depressed.
CP		C/W lts (36) - out	2	
DP		AC IND sel - BUS 2, ØA, B, C AC VOLTS ind - 113-117 vac AC2 RSET - OFF INV 3 AC2 - OFF INV 2 AC2 - on (up)	3	Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when alternate inverter connected to bus.
		AC2 RSET - RSET		RSET position is momentary. Positioning AC1 or 2 RSET switches to RSET and releasing ensures a MASTER ALARM light and tone. Positioning AC1 or 2 RSET switches to center will cause random activation of MASTER ALARM lights and tone.
DP,CP		MASTER ALARM pb/lt (2) - on (push)	3,122	
CP		C/W lts (36) - out	2	
DP		INV 3 - OFF	3	Inverter 1 powering a-c bus No. 1 and inverter 2 powering a-c bus No. 2.
		AC IND sel - BUS 1 & 2, ØA, B, C AC VOLTS ind - 113-117 vac		
	1.5	FLOAT BAG CHECK		
AC		FLOAT BAG (all) - OFF	8	Lever lock.
		cb FLOAT BAG (all) - close		
		FLOAT BAG (all) - VENT		Lever lock.
		cb FLOAT BAG (all) - open		

FLOAT BAG CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	1.6	LHEB ECS VALVE STATUS		
CP		GLY TO RAD SEC vlv - BYP (verify)	377	
		PRIM ACCUM FILL vlv - OFF	379	
		PRIM GLY ACCUM vlv - open (CCW), then 1/8 CW	378	One-eighth clockwise will prevent damage to valve in subsequent checks.
		Y-Y strut - retract		Y-Y strut to be retracted to provide attenuation panel access.
		Open coolant cont atten pnl		Covers panel 382.
		WARNING SUIT FLOW RELF vlv must remain OFF throughout msn or swelling of CO2-odor absorber filters may result.		
		SUIT FLOW RELF vlv - OFF	382	
		GLY EVAP IN TEMP vlv - MIN (CCW)		
		SUIT HT EXCH SEC GLY - FLOW		
		EVAP H2O CONT (2) - AUTO		
		H2O ACCUM (both) - RMTE		
		Close coolant cont atten pnl		
		Y-Y strut - extend & lock in place		
		Open CO2 cstr atten pnl		Covers CO2 canisters.
		CO2 CSTR DIVERT vlv - ctr	350	
		Close CO2 cstr atten pnl		
		MN REG (2) - open	351	
		H2O/GLY TK sel (2) - BOTH		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		EMER CAB PRESS sel - OFF	351	
		CAB REPRESS vlv - OFF (ccw)		
		WASTE TK SERV vlv - CLOSE	352	Servicing fitting is plugged.
		PRESS RELF sel - RELF		
		POT TK IN vlv - as req		Potable water chlorination port capped.
		WASTE TK IN vlv - AUTO		
		PRESS EQUAL vlv - CLOSE	Fwd Hatch	
		Actr handle sel - stowed		
		Actr handle rel - locked		
		TUNL VENT vlv - DM/CM ΔP	12	
		DM/CM ΔP ind - 0.0 psid		Actual pressure differential across forward hatch will be 0.0 psid. However, indicator specification allows 0.025 psid gage error.
		SUIT FLOW vlv (3) - FULL FLOW	300,301,302	
		Cab ht exch louvers - ctr	303	
		PRIM CAB TEMP vlv - COLD (cw)		
		SEC CAB TEMP vlv - MAX COOL (CW)		
		DRINK H2O SUP vlv - OFF	304	Drinking water unavailable during launch hold periods.
		H2O gun probe safety - push lock		
		H2O gun probe fire extg vlv (red) - lock closed		
	1.7	LEB & TIMER PANEL 306		
		UTIL PWR - OFF	100	Connector covered.
		FLOOD DIM - 1		
		FLOOD FIXED - OFF		
		G/N OPT PWR - OFF		
		G/N IMU PWR - on (up)		Guarded.
		G/N LTS - ACl		
		NUMERICS LTS - as desired		
		INTGL LTS - as desired		

LEB & TIMER PANEL 306

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		FLOOD LTS - OFF (CCW)	100	
		MSN TMR - RSET	306	RSET position is momentary.
		MSN TMR ind - zero		
		MSN TMR - START		Mission timer will reset to zero and count up at launch.
		MSN TMR ind - counting up (verify)		
		MSN TMR HRS - ctr		
		MSN TMR MIN - ctr		
		MSN TMR SEC - ctr		
		EVNT TMR START - STOP, then ctr		
		EVNT TMR RSET - RSET		RSET position is momentary.
		EVNT TMR ind - zero		
		EVNT TMR MIN - ctr		
		EVNT TMR SEC - ctr		
		SYS TEST (2) - 5C	101	
		SYS TEST ind - 1.3-5.0 vdc		Equivalent to +40° to +150°F nominal SPS engine valve body temperature.
		SYS TEST (2) - 6C, 7C, 8C		Equivalent to +40° to +110°F nominal SPS oxidizer feed line, SPS fuel checks valve, and SPS oxidizer tank outboard temperatures.
		SYS TEST ind - 1.3-3.7 vdc		Monitors battery relay bus voltage during launch.
		SYS TEST (2) - 3E		
		CM RCS HTRS - OFF		
		WASTE H2O DUMP - HTR A		
		URINE DUMP - HTR A		
		CAUTION		
		OPT ZERO sw must not be moved during prelaunch or inadvertent jett of optics covers could occur.	122	
		OPT ZERO - ZERO		6.1.3, note 4g.
		OPT TELTRUN - SLAVE TO SXT		

1.7 LEB & TIMER PANEL 306

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		OPT MODE - MAN	122	
		OPT COUPLING - DIR		
		OPT SPEED - LO		
		COND LAMPS - TEST		
		MASTER ALARM lt - on		
		STAR ACQ lt - on		
		COND LAMPS - ON		
		UP TLM - ACPT		
		RETCL BRT tw - as req		
		GLYCOL EVAP - NORM	163	
		S1 - OFF	164	Connector covered. Switches are located behind
		TELEMETRY PWR - OFF	400	closeout panel and are disabled.
		INTRLVR PWR - OFF		
		VTR PWR - OFF		
		HEADWHEEL DR MOT - ctr		
		MOTOR ON lt - out		
		TAPE MODE - ctr		
		RECORD lt - out		
		TAPE DRIVE - ctr		Lever lock.
		PLAYBACK lt-out		
		TAPE HEAD CLEAN - NORM		Lever lock.
		CLEAN HEAD lt - out		
		LAMP TEST - STATUS		
		VIDEO PWR - OFF	426	
		VIDEO SOURCE - CM		
		VIDEO TV MODE - PLAYBACK		

LEB & TIMER PANEL 306

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP 1.8	RHEB & PANEL 601		
	C/W TONE ADJUST (3) - as desired	223	
	cb pnl 225 - all closed	225	
	cb pnl 226 - all closed except	226	
	cb COAS/TUNL LTG MNB - open		Prevents exterior spotlight door initiator from operating during launch.
	cb FC RAD BAT RLY (3) - open		
	cb pnl 229 - all closed except	229	
	cb MN REL (2) - open		Prevents premature main parachutes release.
	cb PYRO BUS A BAT BUS A - open		
	cb PYRO BUS B BAT BUS B - open		
	cb UVA EXP MNB - open	230	
	cb UVA COVER MNB - open		
	UVA PWR - OFF		
	UVA LAMPS - OFF		
	UVA COVER - ctr		
	UVA COVER tb - gray		
	ETE PWR - OFF		
	cb pnl 250 - all closed except	250	
	cb MN BUS INTERCONNECT (2) - open		
	OVBD DRAIN vlv - OFF	251	
	BAT VENT vlv - VENT	252	
	WASTE STOW VENT vlv - VENT		
	REPRESS O2 VLV - CLOSE	601	Guarded.
1.9	ORDEAL SWITCH POSITION CHECK		Assumes that ORDEAL box has been interconnected between FDAIs and EDA during installation, and that prime or backup crews will not be required to connect or disconnect ORDEAL cables to stow or unstow ORDEAL.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION Before ORDEAL is stowed, or when not being used (whether EARTH/ LUNAR sw is in PWR OFF or not), FDAI 1 & 2 sw must be in INRTL. Otherwise, pitch inertial att cannot be displayed by FDAI ball.		
AC		FDAI sw (both) - INRTL EARTH/LUNAR - PWR OFF ALT SET cont - as req	13	This value to be determined from planned nominal insertion altitudes for each particular mission.
		LTG - OFF MODE - HOLD/FAST SLEW - ctr		
	1.10	LH COUCH CHECKS		
		THC & RHC 2 - LOCKED		It is possible to actuate THC clockwise or counter-clockwise while locked.
		LH ECS Vlv Stat		
CP		SRG TK RELF vlv - open (CW)	375	
		PLVC sw - NORM	376	
		DEMAND REG sel - BOTH	380	
		SUIT TEST vlv - OFF		
		SUIT RETURN vlv - close (push)		
		PRIM GLY TO RAD - norm (in)	325	
		CAB PRESS RELF vlv (2) - BOOST/ENTR (safety latch off)		For ground checks, CAB PRESS is the equivalent of flight term CAB PRESS RELF.
		GLY RSVR IN vlv - OPEN	326	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		GLY RSVR OUT vlv - OPEN	326	
		GLY RSVR BYP vlv - CLOSE		
		SM O2 SUP vlv - ON		
		SRG TK O2 vlv - ON		
		REPRESS PKG O2 vlv - ON		
		LH Side Pnls		
AC		COAS PWR - OFF	15	
		UTIL PWR - OFF		Connector covered.
		PL BCN LT - off (ctr)		
		DYE MARKER - off (down)		Guarded. Verify safety removed.
		PL VENT - OFF		
		AUTO RCS (16) - OFF	8	
		FLOOD DIM - 1		
		FLOOD FIXED - OFF		
		NUMERICS LTS - as desired		
		FLOOD LTS - as desired		
		INTGL LTS - as desired		
		SECS LOGIC (both) - OFF		Lever lock.
		SECS PYRO ARM (2) - SAFE		Lever lock with lock guard.
		cb pnl 8 - all closed except		
		cb CM RCS HTRS (both) - open		Prevents inadvertent CM RCS jet activation.
		cb FLOAT BAG (all) - open		Prevents inadvertent activation of float bag compressors and sea dye marker.
		cb SECS LOGIC (2) - open		Prevents inadvertent activation of SECS functions.
		cb SECS ARM (2) - open		
		cb SPS GAUGING (4) - open		PUGS deactivated.
		EDS PWR - OFF	7	

1.10 LH COUCH CHECKS

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	CAUTION More than 1 hr of continuous on-time for TVC SERVO PWR 1 or 2 sw may be detrimental to SPS gmbl actuators.		
AC	TVC SERVO PWR (both) - OFF FDAI/GPI PWR - BOTH LOGIC 2/3 PWR - on (up) ELEC PWR - ECA SIG CONDR/DR BIAS PWR (both) - AC1 or AC2	7	Powers RJEC -4 vdc bias power supplies. To provide increased reliability, switches should not be set on same bus.
	BMAG PWR (both) - WARMUP		
	LH, ctr MDC & Pnls 600, 601, 602, 603 & 604 Set ALT index - 3300	1	Value obtained from LCC.
	CMC ATT - IMU		Normally left at IMU position throughout mission. Selection of GDC position causes total attitude display to be lost on both balls. GDC damage will result if GDC position selected and pitch or yaw rate is >5°/sec, or if GDC yaw Euler angle is >80° and <280°.
	ACCEL - check (+0.75 - +1.25 G) FDAI SCALE - 5/1 FDAI SEL - 1/2 FDAI SOURCE - CMC ATT SET - GDC MAN ATT ROLL - RATE CMD MAN ATT PITCH - ACCEL CMD		

LH COUCH CHECKS

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	MAN ATT YAW - RATE CMD	1	
	LIM CYCLE - OFF		
	ATT DBD - MIN		
	RATE - HI		
	THC PWR - on (up)		For ground checks, TRANS CONTR PWR, ROT CONTR PWR NORM, and ROT CONTR PWR DIR are the equivalent of flight terms THC PWR, RHC PWR NORM, and RHC PWR DIR respectively.
	RHC PWR NORM (both) - AC/DC		
	RHC PWR DIR (both) - OFF		
	SC CONT - SCS		
	CMC MODE - FREE		
	BMAG MODE (3) - RATE 2		
	SPS THRUST - NORM		Lever lock.
	LV THRUST (2) - OFF		Guarded.
	SPS GMBL tw (2) - 0		
	ATT SET tw (3) - R ____, P ____, Y ____		
	SCS TVC (2) - RATE CMD		
	GMBL MOT (4) - OFF		Flight term GMBL MOT is equivalent of ground check term SPS GMBL MOT.
	ATVC GAIN - LO		
	ELS LOGIC - OFF		Guarded.
	ELS AUTO - MAN		
	CM RCS LOGIC - OFF		
	CM PRPLNT DUMP - OFF		Guarded.
	CM PRPLNT PURG - OFF		Guarded.
	IMU CAGE - off (down)		Guarded.
	EMS ROLL - OFF		
	.05 G sw - OFF		Required at OFF position until .05 G during entry. OFF position powered by LOGIC 2/3 PWR switch.
	Pc IND sw - Pc		
	Pc ind - zero		
	LV IND/GPI sw - GPI		
	TVC GMBL DR (2) - AUTO		

1.10 LH COUCH CHECKS

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		EVNT TMR START - ctr	1	Event Timer not counting. Timer resets and starts counting automatically when lift-off occurs. Resets and starts counting up in event of abort initiation.
		EVNT TMR RSET - up (ctr) EVNT TMR ind - zero EVNT TMR MIN - ctr EVNT TMR SEC - ctr		
CP		SUIT CAB ΔP ind - >+2.0 in. H20	2	Crewman in LH couch performs LH side panel 2 checks.
		O2 FLOW ind - 0.4±0.1 lb/hr (not pegged)		DIRECT O2 valve partially open.
		PROBE EXTD/REL tb (2) - gray		Gray indicates probe fully extended or fully retracted.
		PROBE (3) - OFF UP TLM CM - ACPT		PROBE EXTD/REL switch guarded. UP TLM CM switch should be placed to ACPT only as required during updates.
		GUID RING (2) - off (ctr) STRUCT LATCH (2) - off (ctr) CAPTURE LATCH (2) - off (down) BACKUP PASSIVE (2) - off (ctr) STRUCT LATCH OPEN pb/lt - push, on/rel, out GUIDE RING EXTEND pb/lt - push, on/rel, out GUIDE RING CAPTURE pb/lt - push, on/rel, out PASSIVE pb/lt - push, on/rel, out STRUCT RING CONTACT pb/lt - push, on/rel, out STRUCT LATCH CLOSE pb/lt - push, on/rel, out		Guarded. Momentary switch. Momentary switch (guarded).
		CM RCS PRESS - off (down)		Guarded.

LH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		RCS Status Check	2	
		SM RCS PSM He - CLOSE		Close position is momentary.
		PSM He tb - bp (verify)		Barber pole indicates at least one of two redundant helium isolation valves closed in propellant storage module.
		SM RCS PSM MANF ISOL - ctr		Positioned to CLOSE prior to backup crew ingress.
		PSM MANF ISOL tb - bp (verify)		Barber pole indicates at least one of four (2 oxidizer and 2 fuel) valves closed in the propellant storage module. If gray, ground should be notified.
		SM RCS QUAD He (4) - ctr		
		SM RCS QUAD He tb (4) - bp (verify)		Barber pole indicates at least one of two redundant helium tank isolation valves in each quad closed.
		SM RCS QUAD PRIM PRPLNT tb (4) - bp (verify)		Barber pole indicates at least one primary propellant isolation valve (fuel or oxidizer) in each quad closed.
		SM RCS QUAD SEC PRPLNT tb (4) - bp (verify)		Barber pole indicates at least one secondary propellant isolation valve (fuel or oxidizer) in each quad closed.
		SM RCS SEC FUEL PRESS (4) - OPEN		OPEN position is momentary. No talkbacks. ACE confirms helium isolation valves at quad secondary fuel tanks open.
		SM RCS PSM PRPLNT (4) - OPEN		OPEN position is momentary. Opening these valves configures the manifold for filling during SM RCS activation.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	SM RCS PSM PRPLNT tb (4) - gray	2	Gray indicates both PSM propellant isolation valve (fuel and oxidizer) in distribution manifolds open at quad.
	SM RCS IND sw - TK PRESS/QTY RCS IND sel - SM A, B, C, D		Check each quad in turn.
	SM RCS PKG TEMP ind - ambient		SM RCS package heaters not operated on pad and during ascent to reduce effects of boost heating on package temperature. Temperature <75° or >205°F illuminates SM RCS status lights.
	SM RCS He TK PRESS ind - 4100-4200 psia (quad) SM RCS FUEL TK PRESS ind - 192-207 psia (quad) SM RCS PRPLNT QTY ind - 100% (quad)		Nominal servicing pressure at 70°F.
	PCS IND sel - PSM SM RCS PKG TEMP ind - zero		Operational only when RCS IND selector at SM A, B, C, or D.
	SM RCS He TK PRESS ind - 4100-4200 psia (PSM) SM RCS FUEL TK PRESS ind - 192-207 psia (PSM)		Nominal servicing pressure. Servicing helium pressure on fuel and oxidizer tanks at 70°F. Regulated helium pressure common manifold readout.
	SM RCS PRPLNT QTY ind - TBD (PSM) SM RCS IND sw - MANF PRESS SM RCS FUEL MANF PRESS ind - ambient psia SM RCS OXID MANF PRESS ind - ambient psia		
	CM RCS PRPLNT (both) - on (up)		On position is momentary.

LH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		CM RCS PRPLNT tb (both) - gray	2	Gray indicates fuel and oxidizer isolation valves open.
		RCS IND sel - CM 1, 2 CM RCS He TK TEMP ind - 60-90°F CM RCS He TK PRESS ind - 4100-4200 psia CM RCS He MANF PRESS ind - 80-105 psia		Check both CM RCS systems 1 and 2 in turn. Nominal servicing pressure. GSE servicing pressure monitored until system activated. Pressure varies with temperature and ullage. If manifold pressure drops suddenly, indicating a ruptured burst diaphragm, close CM RCS propellant isolation valves and then perform procedure for preheating jets (14.1.4) and 20 minutes. Procedure vents any propellant trapped between propellant isolation valves and jets by energizing jet valve direct coils.
		SM RCS QTY ind - zero		Operational only when RCS IND selector at SM A, B, C, or D.
		SYS TEST (2) - 4B, 5B, 6B, 7B, 8B, 9B SYS TEST ind - ambient (vdc)	101	CM RCS temperature of engine jet valves 12 (-R), 14 (-P), 16 (-Y), 21 (+R), 23 (+P), and 25 (+Y) respectively.
		SYS TEST (2) - 10B SYS TEST ind - ambient (vdc)		SM RCS PSM fuel tank temperature.
		SYS TEST (2) - 1C, 2C, 3C, 4C SYS TEST ind - ambient (vdc)		SM RCS primary fuel tank temperatures of quads A, B, C & D respectively.
		SYS TEST (2) - 3B RCS CMD - ctr	2	Switch last set to OFF (momentary position) prior to backup crew ingress.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	RCS TRNFR - SM	2	SM position is momentary.
	EDS AUTO - OFF		
	DOCK RING SEP (2) - off (down)		Guarded.
	CM/SM SEP (2) - off (down)		Guarded.
	SIVB/DM SEP - off (down)		Guarded.
	PRPLNT DUMP - AUTO		
	2 ENG OUT sw - AUTO		
	LV RATES sw - AUTO		
	TWR JETT (both) - AUTO		Guarded.
	LV GUID sw - IU		
	MN REL - off (down)		Guarded.
	EMER O2 VLV - CLOSE	600	
	REPRESS O2 VLV - CLOSE	601	
	REPRESS O2 RELF - open (CW)	602	
	REPRESS O2 PRESS ind - >865 psig		
	IVA STA O2 SUP - OFF	603	
	IVA PWR - OFF	604	
1.11	RH COUCH CHECKS		
	RHC 1 - LOCKED		
	RHEB & Pnl 16		
DP	C/W INPUTS (43) - ENBL	201	
	SCI PWR - OFF	227	
	S5 - off (down)	16	Switch deactivated.
	UTIL PWR - OFF		
	cb panel 274 - all open except	274	
	cb ELECTROPHORESIS (2) - close (verify)		Closed after installation of EPE (MA014) experiment.
	TUNL LTS - OFF		
	EXT RUN LTS - OFF		
	EXT RNDZ/SPOT LTS - off (ctr)		

RH COUCH CHECKS

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	cb pnl 275 - all open except	275	
	cb MNA & B BAT BUS A & B (2) - close		
	cb BAT BUS A & B BAT A & B (2) - close		
	cb pnl 276 - all closed	276	
	cb pnl 278 - all open	278	
	RH Side Pnls		
	MN BUS TIE (2) - OFF	5	
	FC 1 PUMPS - AC1		
	FC 2 & 3 PUMPS - AC2		
	SM RCS ENG PKG HTRS (4) - OFF		
	SM RCS QUAD HTRS (4) - OFF		
	SM RCS PSM HTRS - OFF		
	SPS HTRS - OFF		
	INTGL LTS - OFF		
	FLOOD LTS - OFF		
	FLOOD DIM - 1		
	FLOOD FIXED - OFF		
	BAT CHGR - AC1		
	cb pnl 5 - all closed except		
	cb FLT/PL BUS BAT A, B, C (3) - open		
	cb H2O/URINE DUMP HTRS (2) - open		
	cb EXP BUS MNA, B (2) - open		
	cb EXP PWR A, B, C (3) - open		
	cb IVA PWR (2) - open		
	cb O2 VAC ION PUMPS (2) - open		
	cb UTIL LEB MNB - open		
	cb WASTE DUMP HTRS (2) - open		
	SPS GAUGING - OFF	4	
	TELCOM GRP 1 - AC1		
	TELCOM GRP 2 - AC2		
	GLY PUMPS - 1 AC1 (verify)		

1.11 RH COUNCH CHECKS

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
IP	SUIT COMPR (both) - OFF cb pnl 4 - all closed	4	
	RH MDC Pnls		
	cb FC RAD BAT RLY (all) - close	226	
	FC RAD (all) - off (ctr)	3	Last set to NOPM (momentary) position.
	FC RAD tb (all) - gray		Gray indicates fuel cell radiator panel not bypassing flow.
	cb FC RAD BAT RLY (all) - open	226	Prevents inadvertent FC radiator effective area reduction.
	FC HTRS (all) - on (up)	3	
	FC PURG (all) - OFF		Last set to on (up) (momentary) position.
	FC REACS (all) - ctr		Gray indicates both reactant valves open for each fuel cell.
	FC REACS tb (all) - gray		
	SM PWR SOURCE MNA 1 & 3 - OFF, 2 - ctr		Fuel cell management will be monitored by ground crew until the gimbal drive and trim check at which time they will be verified on the main buses by the crew.
	SM PWR SOURCE MNA 1 & 3 tb - bp, 2 tb - gray		Barber pole indicates fuel cells 1 and 3 disconnected from main bus A, gray indicates fuel cell 2 connected to main bus A.
	MNA RSET - ctr		Last set to RSET (momentary) position.
	SM PWR SOURCE MNB (all) - OFF		
	SM PWR SOURCE MNB tb (all) - bp		Barber pole indicates all fuel cells disconnected from main bus B.
	MNB RSET - ctr		Last set to RSET (momentary) position.

RH COUCH CHECKS

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	FC IND sel - 2 FC H2 FLOW ind - 0.01-0.08 lb/hr FC O2 FLOW ind - 0.1-0.6 lb/hr FC SKIN TEMP ind - 390°-440°F FC COND EXH TEMP ind - 150°-175°F FC PH HI tb - gray BAT CHG - OFF DC IND sel - SM SOURCE 2 DC AMPS ind - 5-30 amps DC IND sel - MNA, B DC VOLTS ind - 26.5-31 vdc DC IND sel - BAT BUS A, B, BAT C DC VOLTS ind - 31.5-38 vdc DC AMPS ind - <3.0 amps DC IND sel - PYRO BAT A, B DC VOLTS ind - 31.5-38 vdc DC IND sel - MNA Dual Inv Stat Check INV 1 - MNA INV 2 - MNB INV 3 - OFF INV 1 AC1 - on (up) INV 2 AC1 - OFF INV 3 AC1 - OFF AC1 RSET - ctr INV 1 AC2 - OFF INV 2 AC2 - on (up) INV 3 AC2 - OFF AC2 RSET - ctr AC IND sel - BUS 1 & 2, ØA, B, C AC VOLTS ind - 113-117 vac	3	Flow limits are proportional to individual fuel cell currents and can be approximated by fuel cell H2 flow ≈(amps x 2.5)/1000, and fuel cell O2 flow ≈(amps x 2.0)/100. GSE is supplying most of the SC power. Gray indicates normal pH factor normal. MNB powered by GSE. Switch position verification only. If switch positions must be changed, refer to 5.3.8, step a.

1.11 RH COUCH CHECKS

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	SPS Stat Checks	3	
	SPS TEMP IND sw - He PNL, OXID LN		
	SPS TEMP ind - 100°F max		Normal operating temperature is +45° to +75°F. Redline is +40° and +100°F.
	SPS FUEL PRESS ind - 170-195 psia		Normal operating pressure after fuel and oxidizer tank is pressurized with He (after He valve is actuated) is 170-195 psia. GSE servicing pressure is 110 psia.
	SPS OXID PRESS ind - 170-195 psia		
	SPS PRESS IND sw - He, N2A, N2B		
	SPS He PRESS ind - 3300-3900 psia		GSE servicing pressure is 3600±50 psia.
	SPS N2 PRESS ind - 2200-2800 psia		GSE servicing pressure is 2500±50 psia at 70°F.
	SPS INJ VLV ind (4) - CLOSE		PUGS deactivated.
	SPS OXID VLV upper tb - gray (verify)		
	SPS OXID VLV lower tb - gray (verify)		PUGS deactivated.
	SPS QTY TEST - ctr		PUGS deactivated.
	OXID FLOW VLV INCR - NORM (verify)		PUGS deactivated.
	OXID FLOW VLV PRIM - PRIM		PUGS deactivated.
	PUG MODE - NORM		
	SPS He VLV tb (both) - bp		Barber pole indicates each helium isolation valve is closed.
	SPS He VLV (both) - AUTO		
	SPS PRESS IND sw - He		
	VHF ANT - SM LEFT		
	S BD XPNDR - OFF		
	S BD PWR AMPL PRIM - PRIM		
	S BD PWR AMPL HI - off (ctr)		
	S BD MODE VOICE - VOICE		
	S BD MODE PCM - PCM		
	S BD MODE RNG - RNG		
	S BD AUX TAPE - ctr		
	S BD AUX TV - ctr		

RH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
BP		UP TLM DATA - DATA	3	
		UP TLM CMD - RSET, then OFF		
		PWR AMPL tb - bp		Barber pole indicates power is not applied to S-band power amplifier.
		TAPE MOTION tb - bp		Barber pole indicates no tape motion.
		S BD ANT OMNI A - B		Guarded.
		S BD ANT OMNI - OMNI		
		VHF AM SQLCH tw (2) - noise +1		
		VHF AM (2) - off (ctr)		
		VHF AM RCV - off (ctr)		
		VHF BCN - OFF		
		VHF RNG - OFF		
		S BD SQLCH - ENBL		
		FC REAC VLV - NORM		
		H2 PURG LINE HTR - OFF		
		TAPE RCDR PCM - PCM/ANLG		
		TAPE RCDR RCD - RCD		Power to switch is provided by the up-data link or the TAPE RCDR FWD switch in FWD position.
		TAPE RCDR FWD - REWIND		Allow tape to completely rewind before proceeding. TAPE MOTION talkback is gray when tape is in motion.
		TAPE RCDR FWD - off (ctr)		
		SCE PWR - NORM		
		PMP PWR - NORM		
		PCM BIT RATE - HI		
		PTT BU - NORM		
CP		MSN TMR - RSET	2	RSET position is momentary. Crewman in RH couch performs RH side panel 2 checks.
		MSN TMR ind - zero		
		MSN TMR - START		Will reset indicator to zero and count up at lift-off, but not abort initiation.
		MSN TMR ind - counting up		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		MSN TMR HRS - ctr MSN TMR MIN - ctr MSN TMR SEC - ctr C/W NORM - ACK (verify) C/W CSM - CSM C/W PWR - 1 (verify) C/W LAMP TEST sw - ctr PL VENT VLV - push (lock) CRYO H2 PRESS ind (both) - 225-260 psia 02 PRESS IND sw - TK 1 CRYO 02 PRESS ind (both) - 865-935 psia 02 PRESS IND sw - SURGE TK CRYO 02 PRESS 1 ind - 865-935 psia CRYO H2 QTY ind (both) - verify quantity CRYO 02 QTY ind (both) - verify quantity CAB FAN (both) - OFF H2 HTRS (both) - AUTO 02 HTRS (both) - AUTO H2 FANS (both) - AUTO ECS IND sel - PRIM RAD PRIM IN TEMP ind - 60°-97°F RAD PRIM OUT TEMP ind - 35°-50°F PRIM GLY EVAP OUT TEMP ind - 35°-45°F PRIM GLY EVAP STM PRESS ind - 0.25 psia (pegged) PRIM GLY DISCH PRESS ind - 60 psig max	2	H2 tank 1 and 2 pressures. 02 tank 1 and 2 pressures. CRYO 02 PRESS indicator 1 reads tank 1 or SRG tank pressures depending on CRYO PRESS indicator switch position. 02 SURGE TK pressure. H2 tank 1 and 2 quantities. 28 pounds nominal at 100 percent (each tank). 02 tank 1 and 2 quantities. 320 pounds nominal at 100 percent (each tank).

RH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		SUIT TEMP ind - 45°-55°F	2	
		CAB TEMP ind - 80°F max		
		SUIT PRESS ind - ≈14.9 psia		
		CAB PRESS ind - ≈14.7 psia		
		CO2 PP ind - 0.0 mm Hg		
		RAD FLOW CONT AUTO - AUTO		
		ECS RAD tb - gray		Gray indicates No. 1 flow proportioning valve controlling flow.
		RAD FLOW CONT PWR - off (ctr)		
		RAD MAN SEL - RAD 1		When switch is powered, by placing RAD FLOW CONT PWR switch to MAN SEL, center position will close all isolation valves.
		RAD PRIM HTR - off (ctr)		
		RAD SEC HTR - OFF		
		SUIT COMPR ΔP ind - 0.0 psid		
		PRIM ACCUM QTY ind - 25-50%		Range shown is for gauge. Comparable corrected range used for prelaunch redlines is 25-55%.
		H2O QTY IND sw - WASTE		
		WASTE H2O QTY ind - <80%		
		SM H2O TK - CLOSE		
		H2O QTY IND sw - POT		
		POT H2O QTY ind - 80%		
		POT H2O HTR - OFF		
		SUIT H2O ACCUM AUTO - ctr		
		SUIT H2O ACCUM ON - ctr		
		SEC COOL EVAP - RSET FOR 58 sec min, then off (ctr)		Ensures secondary loop steam pressure valve closed.
		SEC COOL PUMP - AC2 (verify)		
		SEC EVAP H2O FLOW - off (ctr)		
		GLY EVAP IN TEMP - MAN		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Position prim loop stm press vlv	2	
		GLY EVAP STM AUTO - MAN		
		GLY EVAP STM INCR - INCR for 58 sec min, then DECR for 8.5±0.5 sec		INCR AND DECR positions are momentary. Steam pressure valve requires 58 seconds from full close to full open.
		GLY EVAP H2O FLOW - off (ctr)		
		CAB PRESS DUMP vlv - close (CW)	Side hatch	
	1.12	COMMUNICATIONS CHECK		
	1	Comm Activation		
DP		S BD XPNDR - PRIM	3	
		S BD PWR AMPL PRIM - PRIM		
		S BD PWR AMPL HI - HI		
		PWR AMPL tb - gray (after 90 sec)		Gray indicates power applied to S-band power amplifier.
		VHF AM B - DUPLEX		
CP		S BD ANT ind - >1/3 scale	2	
ALL		MODE (3) - INTERCOM/PTT	9,10,6	
		VOX SENS tw (3) - as req		
		VHF FM/PAD COMM (3) - T/R		
		VHF FM/PAD COMM VOL tw (3) - as req		
		PWR (3) - AUDIO/TONE		
		MASTER VOL tw (3) - as req		
		SUIT PWR (3) - on (up)		
DP		CM/RMTE INTERCOM - T/R	6	
ALL		VHF AM (3) - T/R	9,10,6	
		VHF AM VOL tw (3) - as req		
		S BD (3) - T/R		
		S BD VOL tw (3) - as req		
		AUDIO CONT (3) - NORM		
AC		VHF RNG - NORM	9	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Comm Checks		
[illegible]		Replace facility headsets with CM headsets	9	CM headsets and CWG adapters have been connected to communication control head prior to backup crew ingress at which time PWR and SUIT PWR switches were OFF (panels 6, 10, and 9).
		Perform comm checks (pad comm, S-band, & VHF AM)		
AC		Return to facility headset		
DP		Don CP headset & perform S-band & VHF AM comm checks		Ground will switch communication channel such that S-band modes and VHF AM may be verified.
		UP TLM DATA - UP VOICE BU	3	
		Establish 2-way comm on S-band		
		UP TLM DATA - DATA		
		S BD AUX TAPE - DN VOICE BU		
		Establish 2-way comm on S-band		
		S BD AUX TAPE - ctr		
		Return to facility headset		
	3	At Completion of Comm Checks		
ALL		SUIT PWR (3) - OFF	9,10,6	
		PWR (3) - OFF		
CP		MASTER VOL tw - 6	10	
		INTERCOM VOL tw - as req		
		S BD VOL tw - as req		
		VHF AM VOL tw - as req		
DP		CM/RMTE INTERCOM - OFF	6	
ALL		Disconnect CM headset & CWG adapter from comm cont head		
CP		C/W PWR - off (ctr)	2	
DP		cb C/W (2) - open	5	
		AC & DP egress CM		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		1.13 VERIFY COUCH CONFIGURATION		
BCP		MDC assist bar - extd & locked Headrests - soft suit position THC armrest in launch position & locked Inbd arm rests - stowed & contr locked Couches - launch/entry position (Y-Y struts extd & locked) Seat pans - 85° position & locked O2/comm umb - stowed Harnesses & restraints - extd & laid aside Couch stab brace - stowed Egress CM		Backup CP (BCP) accomplishes all tasks in 1.13 and 1.14. To eliminate confusion, station callouts for AC and DP locations have not been included.
		1.14 PRIME CREW PRE-INGRESS PROCEDURE		
BCP		Ingress CM		Backup CP re-enters CM.
		S BD PWR AMPL HI - OFF	3	The S-band is powered down to allow GMIL station S-band antenna alignment.
		S BD XPNDR - OFF		
		cb C/W (2) - close	5	
		C/W PWR - 1	2	
		C/W MEMORY - RSET		RSET is momentary.
		MASTER ALARM pb/lt - on, push	1,3,122	
		Perform Pot Water Chlor		Performed following launch vehicle propellant loading.
		POT TK IN vlv - OPEN	352	
		Attach needle assy to inj port		Use carry-on sterilization kit for chlorination.
		Insert chlor ampoule into casing		
		Conn knob assy & rot (CW) until piston contacts ampoule		
		Install ampoule assy on needle assy (push & turn CW)		

PRIME CREW PRE-INGRESS PROCEDURE

STA/T STEP	PROCEDURE	PANEL	REMARKS
307	Rot knob (CW) until ampoule is empty (piston bottoms out)	352	Requires ≈5-1/2 turns.
	Disconnect ampoule assy from needle assy (push & turn CCW)		
	Rot knob (CCW), remove used ampoule		
	Repeat chlor inj steps using another chlor ampoule		
	Repeat chlor inj steps using buffer ampoule (do not remove empty ampoule after inj)		Needle assembly to remain on inject port.
	Wait 10 min. Then rot inject barrel (CCW) four turns while holding bayonet section in locked position (CW)		Withdraws one ampoule of water.
	Rot knob (CCW), remove filled ampoule		
	Remove needle assy from inject port		
	Allow 30-45 min after buffer ampoule injection before proceeding to drink gun and food prep valves cycle, 2.1		
	DIRECT O2 vlv - OPEN (CCW), adj for O2 FLOW ind - 0.7-0.9 lb/hr	7 2	
	SUIT COMPR 1 - ACl	4	
	SUIT COMPR ΔP ind - 0.5-0.9 psid		
	SUIT CAB ΔP ind - +2.0 in H2O		
	MASTER ALARM pb/lt - push then release c/w lights (all) - out	1,3	Verifies that suit compressor or is operating above c/w limits.
	Verify PO2		
	SECS PYRO ARM (2) - SAFE (remove guard)	8	
	S BD XPNDR - PRIM	3	
	S BD PWR AMPL HI - HI		
	Ingress LEB for prime crew ingress support		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.0 PRIME CREW PRELAUNCH CHECKS		
	2.1 INGRESS AND STATUS CHECKS		
BCP	Drink gun & food prep valves cycle		
	Attach H20 sampling container to food prep unit H20 probe		
	FOOD PREP HOT H20 vlv - push, rel until 40 oz water withdrawn	305	
	FOOD PREP COLD H20 vlv - push, rel until 20 oz water withdrawn		
	Remove H20 sampling container from food prep unit and attach to drink gun nozzle		
	DRINK H20 SUP vlv - ON	304	
	Actuate drink gun control until 2-4 oz removed		
	DRINK H20 SUP vlv - OFF		
	POT TK IN vlv - as req at closeout	352	
	WASTE TK IN vlv - AUTO		
	Remove H20 sampling container from drink gun nozzle	304	
	Remove sterilization kit from CM		
	2.1.1 AC Ingress to LH Couch		
	Ingress LH couch		
	AC comm umbilical - connect to PGA		
	SUIT PWR - on (up)	9	
	PWR - AUDIO/TONE		
	lh SUIT FLOW vlv - OFF	301	
	AC 02 umbilicals - connect to PGA		Connect red to red and blue to blue. Suit hose interconnect removed from CM.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		1h SUIT FLOW vlv - FULL FLOW	301	
		AC O2 ventilator - shut off and disconnect		PGA gas connector plugs installed. Ventilator removed from CM.
		Assist AC in position; connections and adjustments completed		Restraints connected and tightened, and arm rests, torso and life vest adjusted. Helmet protector removed from CM.
AC		CAB FAN (both) - ON	2	
		Verify switch positions as follows		
		FLOAT BAG (all) - VENT	8	Lever lock.
		THC - neutral (LOCKED)		
		MAN ATT ROLL - RATE CMD	1	
		MAN ATT PITCH - ACCEL CMD		
		MAN ATT YAW - RATE CMD		
		SCS TVC (2) - RATE CMD		
		ATVD GAIN - LO		
	2.1.2	DP Ingress to RH Couch		
DP		Ingress RH couch		
		DP comm umbilical - connect to PGA		
		SUIT PWR - on (up)	6	
		PWR - AUDIO/TONE		
Tech		rh SUIT FLOW vlv - OFF	300	
		DP O2 umbilicals - connect to PGA		Connect red to red and blue to blue. Suit hose interconnect removed from CM.
		rh SUIT FLOW vlv - FULL FLOW		
		DP O2 vent - shut off & disconnect		PGA gas connector plugs installed. Ventilator removed from CM.

AC INGRESS TO LH COUCH

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Assist PLT in position; connections and adjustments completed		Restraints connected and tightened, and arm rests, torso and life vest adjusted.
		Verify the following		
DP		SPS GAUGING - OFF	4	PUGS deactivated.
		GLY PUMPS - 1 AC1		
		VHF ANT - SM LEFT	3	
		OXID FLOW VLV INCR - NORM		PUGS deactivated.
		MNA RSET - RSET		RSET position is momentary.
		MNB RSET - RSET		RSET position is momentary.
		SPS He VLV (both) - AUTO		
		S BD ANT OMNI A - B		
		S BD ANT OMNI - OMNI		
		VHF BCN - OFF		
		SCE PWR - NORM		
		AC1 RSET - RSET		RSET position is momentary.
		AC2 RSET - RSET		RSET position is momentary.
	2.1.3	CP Ingress to Center Couch		
CP		Ingress ctr couch		
		CP comm umbilical - connect to PGA		
Tech		SUIT PWR - on (up)	10	
		PWR - AUDIO/TONE		
		ctr SUIT FLOW vlv - OFF	302	
		CP O2 umbilicals - connect to PGA		Connect red to red and blue to blue. Suit hose interconnect removed from CM.
		ctr SUIT FLOW vlv - FULL FLOW		
		CP O2 ventilator - shut off and disconnect		PGA gas connector plugs installed. Ventilator removed from CM.
		Assist CP in position; connections and adjustments completed		Restraints connected and tightened, and arm rests, torso and life vest adjusted. Helmet protector removed from CM.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Perform final crew verification		Helmets, umbilicals, PGA diverter valves and wrist disconnects, foot restraints, and life vests rechecked.
		Verify the following		
CP		PRPLNT DUMP - AUTO	2	
		C/W NORM - ACK		
		MSN TMR - START		
		SUIT COMPR ΔP ind - 0.7-0.9 psid		
		Technician egress CM		
DP		UP TLM CMD - NORM	3	
CP		UP TLM CM - BLOCK	2	
BCP		VHF FM/PAD COMM - OFF	10	PAD COMM can be used after launch for intercom backup with PAD COMM VOL thumbwheel decreased.
CP		SUIT H20 ACCUM AUTO - 1	2	
BCP		Egress CM		
	2.1.4	EDS Checkout and Countdown Test		Crew participation in EDS test directed by ground personnel. Test required ≈30 minutes.
AC		cb EDS (all) - close (verify)	8	
		EDS PWR - on (up)	7	
CP		EDS AUTO - on (up)	2	
AC		ABORT lt operation - verify	1	AC will verify ABORT light operation as it is activated by ground.
DP		UP TLM CMD - OFF	3	
AC		S BD - OFF	9	AC will participate in EDS test on PAD COMM.
		INTERCOM - OFF		
		VHF AM - OFF		
DP		VHF FM/PAD COMM - OFF	6	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.1.5 TV Camr Checkout (TBD)		
	2.1.6 Cabin Closeout		
-01:40:00			
CP	Side hatch closing		
Tech	Verify external tool stowed on outside of hatch	Side hatch	
	Remove hatch seal protector		
	Verify safety pin has been removed from actr handle sel		
	Gear box sel - N (neutral)		
	Actr handle set - N (neutral)		
	GN2 vlv handle - push (outboard)		Squeeze handle to unlock.
	Verify piston chamber pressurized		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If piston chamber is not pressurized		
Tech	GN2 charge No. 1 - CW (tech)	Side hatch	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
Tech	Hatch open lock - rel	Side hatch	
	Push hatch to near closed position		
CP	Lock pin rel knob - UNLOCK (verify)		
	Hold hatch closed		
Tech	Insert tool B, (handle in 9 o'clock position) into external hatch actuation socket, rotate CW to stops and hold		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP Tech	Press and hold LOCK PIN reset button Relax torque & remove tool B		Obtains lock pin engagement. Mechanism should rotate ≈14 degrees CCW because of spring pressure.
CP	LOCK PIN reset button - rel LOCK PIN ind - not extended (rh couch) &/or white ind is opposite white mark (ctr and lh couch) Lock pin rel knob - LOCK (verify)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
Tech	If lock pin is not engaged Insert tool B into external hatch actuation socket & slowly rotate CCW until DP verifies lock pin engagement		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	NOTE		
CP	If RED lock pin extended ≈0.5 inch, lock pin has been sheared.		
CP	GN2 press ind - green (verify) Configure hatch for rapid egress Gear box sel - UNLATCH Actr handle sel - U (unlatch) BPC JETT knob - arrow on knob pointing to BPC JETT decal	Side hatch	

STA/T STEP	PROCEDURE	PANEL	REMARKS
-01:35:00	If rapid hatch opening req, refer to 20.1.1		
	Strut unlock lanyard (2) - unstow and attach handle ends to MDC 2		
	Ground performs cabin purge & hatch leak test		
	Cabin purge to 60% 02/40% N2 (launch atmosphere)		GSE verifies 60:40 ratio.
	Ground performs hatch leak test		Requires ≈20 minutes.
	CAUTION During this check, established SUIT/CAB ΔP should be maintained by DIRECT 02 valve.		
	2.1.7 Change Launch Azimuth (if necessary)		
CP	Key V78E	2	
	FL V06 N29		
	Xsm launch azimuth XXX.XX DEG		Xsm - X stable member.
	Key V21E, load new azimuth		
	PRO		
	CAB FAN (both) - OFF		
	2.1.8 EDS Test Complete		
-01:21:00			
	Set controls after test		
AC	INTERCOM - T/R	9	
	VHF AM - T/R		
	S BD - T/R		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	VHF FM/PAD COMM - T/R	6	
AC	EDS PWR - OFF	7	
CP	EDS AUTO - OFF	2	
	2 ENG OUT sw - AUTO (verify)		
	LV RATES sw - AUTO (verify)		
	DC IND sel - BAT C	3	
	DC VOLTS ind - 32.0 vdc min		
	DC IND sel - MNA		
AC	Pc ind - ____	1	
-01:13:00			
	2.2 FINAL VERIFICATION AND SYSTEMS CHECKS		
	2.2.1 G&C Verification		
	1 Gyro Powerup		
CP	C/W NORM - NORM	2	
	BMAG TEMP lt (both) - out		
AC	FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
	ELEC PWR - GDC/ECA		
	BMAG PWR (both) - ON		
	FDAI/GPI PWR - BOTH		
CP	C/W NORM - ACK	2	
	2 GDC Alignment		
AC	FDAI SEL - 1	1	
	FDAI SOURCE - ATT SET		
	ATT SET tw (3) - R 162°, P 90°, Y 0°		Nominal angles for a 72° launch azimuth and agree with prelaunch TCP. Only roll affected by variable launch azimuth.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		GDC ALIGN pb - push		
		FDAI 1 - errors null		
		ATT SET tw (3) - R 168°, P 84°, Y 354°,		These Euler inputs result in 5° body axes errors from alignment angles.
		FDAI 1 - errors full scale (verify) R right, P up, Y right		
		FDAI SEL - 2		
CP		FDAI 2 - ind same as FDAI 1 (verify)	2	
AC		GDC ALIGN pb - push	1	
		FDAI 2 - errors null	2	
		ATT SET tw (3) - R 162°, P 90°, Y 0°	1	
CP		FDAI 2 - errors full scale (verify) R left, P down, Y left	2	
AC		FDAI SEL - 1	1	
		FDAI 1 - ind same as FDAI 2 (verify)		
		GDC ALIGN pb - push		
		FDAI 1 - total att (verify) R 162°, P 90°, Y 0°		
		WARNING Sequencers in SECS should be deactivated to preclude an inadvertent abort.		
		SECS PYRO ARM (2) - SAFE (verify)	8	Lever lock.
		SECS LOGIC (both) - OFF (verify)		Lever lock.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.2.2 Gimbal Drive and Trim Check		Verifies trim control and manual (MTVC) control capability of primary and secondary gimbal control system. SPS gimbal angle settings based on CSM c.g. and vary with propellant loading. PITCH and YAW GMBL caution/warning lights (panel 2) indicate overcurrent to gimbal motors. Otherwise, no indication to crew, except for switch selection, that a gimbal motor not operating or auto switchover (THC-CW) has taken place. GMBL POS indicator response opposite to RHC commands as follows: RHC: + Pitch, - Pitch, + Yaw, - Yaw IND: - Pitch, + Pitch, - Yaw, + Yaw
	1 Initialization FC on main buses (verify)		Fuel cells are placed on main buses by crew prior to primary TVC check per ground crew instructions.
DP	SM PWR SOURCE 1 & 2 MNA - ctr, 3 MNA - OFF SM PWR SOURCE MNA tb - 1 & 2 gray, 3 bp	3	Gray indicates fuel cells 1 and 2 connected to main bus A; barber pole indicates fuel cell 3 disconnected from main bus A.
	SM PWR SOURCE 1 & 2 MNB - OFF, 3 MB - ctr SM PWR SOURCE MNB tb - 1 & 2 bp, 3 gray		Barber pole indicates fuel cells 1 and 2 disconnected from main bus B; gray indicates fuel cell 3 connected to main bus B.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		MN BUS TIE BAT A/C - on (up)	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches.
		Verify bat bus A current incr &/or bat volts decr	3	
		MN BUS TIE BAT B/C - on (up)	5	
		Verify bat bus B current incr &/or bat volts decr	3	
AC		SCS TVC (2) - RATE CMD (verify)	1	
		CAUTION More than 1 hr of continuous on-time for TVC SERVO PWR 1 or 2 sw may be detrimental to SPS gmbl actuators.		
		TVC SERVO PWR 1 - AC1/MNA	7	
		TVC SERVO PWR 2 - AC2/MNB		
		LV IND/GPI sw - GPI (verify)	1	
		RHC PWR NORM 2 - AC		
		RHC 2 - ARMED		
	2	Prim TVC Check GMBL MOT P1, Y1 - START		START position is momentary. Start SPS gimbal motors sequentially at ≈1-second intervals to avoid power surge. For ground checks, GMBL MOT PITCH or YAW are the equivalent of flight terms GMBL MOT P or Y.
		Confirm trim cont on inds SPS GMBL tw (2) - + & -		Gimbals drive in response to SPS pitch and yaw thumbwheel movement. Verifies primary gimbal trim control.
		RHC 2 - perform MTVC check		Gimbals drive in response to RHC movement, and return to set-in values when RHC is neutral. Verifies primary MTVC loops.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Sec TVC Check		
AC		SCS TVC (2) - AUTO	1	
		GIMBL MOT P2, Y2 - START		START position is momentary.
		THC - CW		
		Confirm trim control on inds		
		SPS GIMBL tw (2) - + & -		Verifies secondary gimbal trim control.
		PHC 2 - perform MTVC check		Verifies secondary MTVC loops.
	4	Auto Switchover Check		
DP		DC IND sel - SM SOURCE 3	3	
		DC AMPS ind - monitor for amps decr after each No. 2 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GIMBL MOT P2, Y2 - OFF	1	Shut off gimbal motors sequentially to avoid power surge. Shutdown of No. 2 motors first minimizes switching in servo logic.
		Verify no MTVC		
		THC - neut		
		SPS GIMBL tw (2) - P___°, Y___°		Gimbals are trimmed to thrusting values. These values are derived from Operational Trajectory, Table VIIIa, and include gimbal offset of ____ in pitch and ____ in yaw from spacecraft axis.
DP		DC IND sel - SM SOURCE 1 (2)	3	
		DC AMPS ind - monitor for amps decr after each No. 1 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GIMBL MOT P1, Y1 - OFF	1	
DP		DC IND sel - MNA	3	
AC		RHC PWR NORM 2 - AC/DC	1	
		RHC 2 - LOCKED		
DP		MN BUS TIE (2) - OFF, then AUTO	5	Positioned to OFF to allow motor switches to cycle and remove batteries from main buses, then to AUTO in case of a pad abort.
AC		TVC SERVO PWR (both) - OFF	7	
		LV IND/GPI sw - SIVB		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.2.3 FDAI Verification		
AC	FDAI SEL - 1/2 FDAI SOURCE - CMC FDAI 1 - total att R X°; P 90°; Y 0°	1	FDAI 2 is drifting as a function of earth rate.
	2.2.4 RSI Test & Setup		For ground checks, EMS RAI is the equivalent of flight term RSI.
	EMS ROLL - on (up) GDC ALIGN pb - push & hold ATT SET YAW tw - adj thru 45° angle, observe RSI tracks =45°, then adj until RSI points up		Avoid FDAI gimbal lock region.
	GDC ALIGN pb - rel EMS ROLL - OFF Align GDC to IMU		Ensures that GDC is aligned to actual IMU angles, rather than calculated values. Attitude reference comparison (in orbit) will be more accurate.
	FDAI SEL - 1 FDAI SOURCE - ATT SET		Constraint: If CMC is on, an overload in IMU resolver circuitry may cause an ICDU oscillation and trigger ISS warning light. FDAI must be used as a null meter in this mode of operation. If not, large errors will result because of impedance mismatch.
	ATT SET - IMU ATT SET tw (3) - null FDAI 1 err ATT SET - GDC		Enables attitude set inputs to GDC.
	GDC ALIGN pb - push & hold until GDC aligned FDAI SOURCE - CMC FDAI SEL - 1/2		Enables attitude set inputs to GDC and disables RHAG inputs.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.2.5 EMS Preparation		
AC	Set EMS ΔV EMS MODE - STBY (verify) EMS FUNC - ΔV SET Set ΔV ind - 1999.9 fps EMS FUNC - ΔV	1	
-55:00			
CP	C/W NORM - BOOST	2	Inhibits master alarm light on panel 1.
DP	UP TLM CMD - NORM	3	
	2.2.6 Pad Abort Enable		
	WARNING After pad abort enable, operation of THC - CCW will initiate an abort.		
-44:00			
AC	EDS PWR - on (up)	7	
CP	Gear box sel - LATCH	Side	
	Actr handle sel - U (unlatch) (verify)	hatch	
	Monitor cabin press		Required to preclude pressure buildup due to
	CAB PRESS ind - >15.8 psia	2	DIRECT 02 vlv purge flow.
	rh CAB PRESS RELF vlv - Dump for 12 sec, then BOOST/ENTRY	325	
ALL	Shoulder harness - locked		
AC	CM RCS LOGIC - on (up)	1	
	cb SECS ARM (2) - close	8	
	cb SECS LOGIC (2) - close		
	SECS LOGIC (both) - on (up)		Lever lock.

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Report logic arm After GO from STC		STC (Systems Test Conductor).
	SECS PYRO ARM (2) - on (up)		Both lever lock pyro arm switches must be operated. LES pad abort capability enabled; SECS LOGIC and PYRO buses are armed.
	2.2.7 SM RCS Activation		
CP	SM RCS PSM PRPLNT tb (4) - gray (verify)	2	Gray indicates both PSM propellant isolation valves (fuel and oxidizer) in distribution manifolds open at quad.
	PSM He tb - bp (verify)		Barber pole indicates at least one of two helium isolation valves closed in propellant storage module.
	SM RCS PSM MANF ISOL - OPEN		OPEN position is momentary. Opening PSM 1 manifold isolation valves fills the SM RCS manifold with propellant to the engine interface.
	PSM MANF ISOL tb - gray		Gray indicates both fuel and both oxidizer isolation valves open in propellant storage module.
	SM RCS PSM PRPLNT (4) - CLOSE		CLOSE position is momentary.
	SM RCS PSM PRPLNT tb (4) - bp		Barber pole indicates at least one of four PSM propellant isolation valves (fuel or oxidizer) in PSM manifold is closed.
-45:00 to -15:00	SM RCS QUAD He (4) - OPEN		OPEN position is momentary.
	SM RCS QUAD He tb (4) - gray		Gray indicates both helium tank isolation valves open in each quad.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		RCS IND sel - SM A, B, C, D RCS IND sw - TK PRESS/QTY SM RCS FUEL TK PRESS ind - 192-207 psia (quad) SM RCS QTY ind - 100% (quad) RCS IND sel - PSM RCS IND sw - MANF PRESS SM RCS FUEL MANF PRESS ind - 130-150 psia (distrib) SM RCS OXID MANF PRESS ind - 150-170 psia (distrib)	2	
		SM RCS SEC FUEL PRESS (4) - CLOSE		CLOSE position is momentary. No talkbacks. ACE can confirm helium isolation valves at quad secondary fuel tanks closed.
		SM RCS QUAD PRPLNT (4) - OPEN		OPEN position is momentary.
		SM RCS QUAD PRIM PRPLNT tb (4) - gray		Gray indicates primary fuel and oxidizer isolation valves open.
		SM RCS QUAD SEC PRPLNT tb (4) - gray		Gray indicates secondary fuel and oxidizer isolation valves open.
	2.2.8	SM RCS Status Check		
		RCS IND sel - SM A, B, C, D		Check each quad in turn.
		SM RCS PKG TEMP ind - ambient		SM RCS package heaters not operated on pad or during ascent, to reduce effects of boost heating on package temperature. Temperature <75° or >205° F illuminates SM RCS status lights.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	SM RCS He TK PRESS ind - 4100-4200 psia (quad) RCS IND sw - TK PRESS/QTY SM RCS FUEL TK PRESS ind - 192-207 psia (quad) SM RCS QTY ind - 100% (quad) RCS IND sel - PSM	2	Nominal servicing pressure at 70°F.
	SM RCS PKG TEMP ind - zero		Operational only when RCS IND selector at SM A, B, C, or D.
	SM RCS He TK PRESS ind- 4100-4200 psia (PSM) SM RCS FUEL TK PRESS ind - 130-150 psia (PSM) SM RCS QTY ind - TBD (PSM) SM RCS IND sw - MANF PRESS SM RCS FUEL MANF PRESS ind 130-150 psia (distrib) SM RCS OXID MANF PRESS ind - 150-170 psia (distrib) RCS IND sw - TK PRESS/QTY RCS IND sel - SMD		Nominal servicing pressure. Servicing helium pressure on fuel and oxidizer tanks at 70°F. Propellant (fuel and oxidizer) distribution manifold pressure same as PSM propellant tank servicing pressure.
	2.3 LAUNCH PREPARATION		
-25:00	Change launch azimuth (if necessary) Key V78E FL V06 N29 Xsm launch azimuth XXX.XX DEG Key V21E, load new azimuth PRO		Xsm - X stable member.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Align GDC to IMU		Ensures that GDC is aligned to actual IMU angles, rather than calculated values. Attitude reference comparison (in orbit) will be more accurate.
		CAB FAN (both) - OFF		
AC		FDAI SEL - 1	1	Constraint: If CMC on, an overload in IMU resolver circuitry may cause an ICDU oscillation and trigger ISS warning light. (Reference ICD MHC1-01325-216.) FDAI must be used as a null meter in this mode of operation. If not, large errors will result because of impedance mismatch.
		FDAI SOURCE - ATT SET		
		ATT SET tw (3) - null FDAI 1 errors		
		ATT SET - GDC		Enables attitude set inputs to GDC.
		GDC ALIGN pb - push & hold until GDC aligned		Enables attitude set inputs to GDC and disables BMAG inputs.
		FDAI SOURCE - CMC		
		FDAI SEL - 1/2		
		AUTO RCS A/C ROLL (4) - OFF (verify)	8	
		AUTO RCS B/D ROLL B1 & B2 - MNA		
		AUTO RCS B/D ROLL D1 & D2 - MNB		
		AUTO RCS PITCH A3 & C4 - MNB		
		AUTO RCS PITCH C3 & A4 - MNA		
		AUTO RCS YAW B3 & D4 - MNA		
		AUTO RCS YAW D3 & B4 - MNB		
		FDAI 1 - total att R ___°, P ___°, Y ___°	1	FDAI 2 drifting as a function of earth rate.
		FDAI SCALE - 5/5		Roll attitude error is scaled in P11. Roll full scale deflection will be 20° not 5° as position indicates.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		RATE - HI	1	
		THC PWR - on (up)		
		RHC PWR DIR (both) - MNA/MNB		
		CMC MODE - FREE		
		BMAG MODE (3) - RATE 1		This position provides most reliable configuration in event a rate gyro fails during boost.
		RHC 2 - ARMED		
-15:00		CTE update/verification		
DP		DC IND sel - BAT C	3	
		DC VOLTS ind - 35-37.5 vdc		
		DC IND sel - MNA		
CP		EDS AUTO - on (up)	2	
		2 ENG OUT sw - AUTO (verify)		
		LV RATES sw - AUTO (verify)		
		RCS CMD - OFF, then ctr		Switch last set to OFF (momentary position) prior to backup crew ingress.
AC		TVC SERVO PWR 1 - AC1/MNA	7	
		TVC SERVO PWR 2 - AC2/MNB		
-10:00				
DP		FC REAC VLVS - LATCH	3	
-08:30				
CP		SEC COOL PUMP - AC2 (verify)	2	
-08:00		Systems status report		
		Astro Launch Operation Voice Check		
DP		S BD - OFF	6	
AC		VHF AM - OFF	9	
		MCCH Voice Check		
DP		S BD - T/R	6	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		VHF A: - T/R	9	
		GSE THRUST - OPEN (verify)	1	Lever lock.
		LV THRUST (2) - OFF (verify)		Guarded.
		Tb IND sw - Pc (verify)		
-06:00		Systems M/MT Ps for Launch		
-04:10				
AC		LV ENG Lts (all) - on		Launch vehicle engine lights on T -04:10 minutes.
		Astro Launch Operation Voice Check		
CP		Verify P02		
		CAUTION Do not press ENTR after keying V75. If ENTR is pressed, G&C system will receive incorrect liftoff time.		
CP		Key V75	2	Used in case hardware does not set proper bit (for P11 selection) when umbilical is removed.
-03:00				
CP		TAPE RCDR FWD - FWD	3	
		TAPE MOTION tb - gray		Gray indicates tape in motion.
-02:15				
AC		PRIM GLY TO RAD - BYP (pull)	325	Accomplished immediately after GSE water-glycol pump deactivated (T -02:15).
CP		PRIM GLY DISCH PRESS ind - 39-52 psig	2	
		PRIM ACCUM QTY ind - 25-50%		Range shown is for gauge. Comparable corrected value used for prelaunch redlines 25-55%.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
-01:15				
DP		MN BUS TIE A/C - on (up)	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches.
		Verify bat bus A current incr &/or bat volts decr	3	
		MN BUS TIE BAT B/C - on (up)	5	
		Verify bat bus B current incr &/or bat volts decr	3	
-01:00				
AC,DP		VHF FM/PAD COMM (2) - OFF	9,6	PAD COMM can be used after launch for intercom backup with PAD COMM VOL thumbwheel decreased.
		VHF AM VOL tw - incr above normal listening level		Compensate for increased noise environment during boost.
-00:45				
AC		GDC ALIGN pb - push, hold	1	
CP		FDAI 2 total att - no motion	2	
AC		GDC ALIGN pb - rel	1	
		READY FOR IGNITION		
		Refer to Appendix A for cabin switch/ control position at vehicle liftoff.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		3. BOOST AND INSERTION		
		3.1 BOOST		
-00:03		Ignition		LV engines lights (8) go on at T -4:10 min when S-IB indicating circuits are armed.
AC -00:01		LV ENG lts (all) - out	1	Indicates all eight engines have achieved over 90 percent of rated thrust.
00:00		LIFT OFF lt - on &	00:00	Time base 1 initiate T +0.2 sec.
		NO AUTO ABORT lt - out		Additional lift-off cues: Event timer start Voice communications from STDN DSKY displays program 11
		MODE 1A		
		WARNING		
		Do not press LIFT OFF/NO AUTO ABORT pb if LV RATE or any LV ENG lts on.		Manual abort initiation may be required. (Refer to mission rules.)
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Liftoff verified If LIFTOFF lt off - push If NO AUTO ABORT lt on - push		Guarded. Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
		RATEC 1 ±4°/sec P,Y ±20°/sec R	
AC	Verify EVNT TMR ind resets to zero & starts counting up		
	xxxxxxxxxxxxxxxxxxxxxxxxx EVNT TMR START - START xxxxxxxxxxxxxxxxxxxxxxxxx		START position is momentary.
CP	Verify MSN TMR ind resets to zero & starts counting up		
	xxxxxxxxxxxxxxxxxxxxxxxxx MSN TMR - RSET/START xxxxxxxxxxxxxxxxxxxxxxxxx		RSET position is momentary.
	Verify P11 (auto)		P11 calculations based on pad-loaded data representing the nominal attitude profile for boost to earth orbit insertion. V82, N32, and N50 available during P11. However, a meaningful display of N32 and N50 is available only during R30 (V82E). V82 should not be selected during P02 or P11 within 5 seconds of lift-off time (this applies to any extended verb which sets bit 1 of flagword 4).
	xxxxxxxxxxxxxxxxxxxxx No P11 - Key ENTR xxxxxxxxxxxxxxxxxxxxx	MODE 1A	V75 inserted in P02 prior to lift-off.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		V06 N62 VI XXXXX. FPS H dot XXXXX. FPS H pad XXXX.X NM	2	Dynamic, non-flashing display parameters updated throughout ascent. VI = Inertial velocity. H dot = Altitude rate. H pad = Altitude above pad radius.
AC		If LV GUID lt - on, from T +0 to T +01:40	1	
CP		LV GUID sw - CMC	2	Allows CMC automatic steering (polynomial guidance) for S-IB stage, and attitude hold commands only, for SIVB stage. Also provides capability of issuing RHC commands via CMC, provided configuration digit in N46 is 3 and V46E is keyed.
		If man cont req Key V46E	MODE 1A	Disables CMC steering and activates Saturn DAP; RHC provides discrete rate (steering) commands to IU for booster control. The attitude error needles are not designed to provide meaningful "fly to" information in manual mode.
AC +00:10		Roll/Pitch prog report		
	+00:55	Roll prog - complete		
CP 13K' to 15K'		CAB PRESS ind - starts decr		Relieves high CM-to-atmosphere ΔP. Assuming that cabin pressure at lift-off is 14.47 to 14.87 psia, the cabin pressure relief valve could begin modulating at 13K'.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If no decr by 25K'		
CP	rh CAB PRESS RELF vlv -	325	
	DUMP (safety latch		
CP	off until CAB PRESS	2	
	ind - 8 psia, then		
AC	NORM (safety latch on)	325	
	If still no decr	MODE 1A	
CP	CAB PRESS DUMP vlv -	Side hatch 2	
	open (CCW) until		
	CAB PRESS ind -		
	8 psia, then close		
	(CW)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
+01:01	PRPLNT DUMP - RCS CMD	01:01	
	MODE 1B - report	MODE 1B	
+01:15	MAX Q		
+01:40	If all engines GO		
	2 ENG OUT sw - OFF		
	LV RATES sw - OFF		
	EDS AUTO - OFF (report)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	GND verifies 1 eng out prior		
	to 01:40		
	Immediately		
	2 ENG OUT sw - OFF		Inhibits subsequent 2 engine out auto abort.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		At 02:00 LV RATES sw - OFF EDS AUTO - OFF (report)	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
+01:48		MODE 1C - report (R3 = 16.5 NM)	01:48 MODE 1C	
AC +02:10		CMC BOOST POLYNOMIAL ends Report GO/NO GO for staging		Time base 2 initiate T +02:14.6.
+02:19		IECO (LV ENG 5, 6, 7, & 8 lts - on) LIFT OFF lt - out (IECO +0.6 sec)	1	Inboard engines cutoff.
+02:21		OECO (LV ENG 1, 2, 3, & 4 lts - on)		Outboard engines cutoff. Time base 3 initiate T +02:20.6.
+02:23		All eng lts - out	RATES ±10° sec P,Y ±20° sec R	S-IB/SIVB separation.
+02:24		LV ENG 1 lt - on	MODE 1C	SIVB engine ignition.
+02:27		LV ENG 1 lt - out		SIVB engine 65 percent rated thrust.
CP +02:51		TWR JETT (both) - on (up) (TFF >1+20) (OECO +30 sec, nom or 1 eng out) (OECO +34 sec, 2 eng out)	02:51 MODE II	2 Guarded. On position is momentary.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		No tower jett Go to EMER PROCEDURES, 20.2.7	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		TWR JETT & MODE II - report Activate Saturn DAP		Activating DAP early will prevent an overspeed if a guidance failure occurs near insertion.
		V46E, V46E, N62E	MODE II	V46E keyed twice to properly activate DAP (if not keyed twice, DAP may not be properly activated because of possible unfavorable internal timing).
		If man cont req LV GUID sw - CMC		RHC provides discrete (steering commands to IU for booster control. Attitude error needles not designed to provide meaningful "fly to" information in manual mode.
AC		MAN ATT PITCH - RATE CMD GLY EVAP STM AUTO - AUTO GLY EVAP H2O FLOW - AUTO	1 2	
+02:57		LV guidance init	MODE II	
+03:25		Guidance good		
+04:00		Report status		
DP				
+05:00		Report status		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	+[illegible]	Report status		
CP	+[illegible]	SED ANT OMNI - D	3	
CP	+07:00	Report status		
AC		LV IND/GPI sw - GPI	1	Ground will monitor LV-FTP during time GPI displayed and will inform crew of any problem.
DP		Monitor main bus voltages during gmbl mot start	3	
AC		GMBL MOT (4) - START Check GPI	1	START position is momentary. Start SPS gimbal motors sequentially at 1-second intervals to avoid power surge.
		LV IND/GPI sw - SIVB		
DP	+08:00	Report status		
	+09:00	GO/NO GO for orbit - report		
	+09:41	MODE IV - report		
AC		If CMC takeover exercised during thrusting go to backup for SECO		SIVB cutoff must be manually initiated at a TBD time calculated during the boost.
	+09:49	Monitor SECO LV ENG 1 lt - On		SIVB engine cutoff (auto). Time base 4 initiate.
CP		Begin TB4 SECO - report		Timebase 4.

MODE II
09:28
MODE IIIA
09:41
MODE IV
09:39
MODE IIIB

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	If late SECO or LV GUID sw - CMC	2	
	WARNING	MODE IV / MODE IIIB	
AC	THC must be returned from CCW position before 3.0 sec or CSM SLA sep will occur.		
	THC - CCW, return within 1 sec SECO LV ENG 1 lt - on Begin TB4	1	
	xxxxxxxxxxxxxxxxxxxxxxxxxx		
		INSERTION	
CP	Rcd from DSKY VI XXXXX. FPS H dot XXXXX. FPS H pad XXXX.X NM	2	VI = Inertial velocity. H dot = Altitude rate. H pad = Altitude above pad radius.
	(R30, Orbital Parameters)		Displays orbital parameters (N44). A meaningful display of N32 and N50 is available only during R30.

START STEP	PROCEDURE		PANEL	REMARKS
CT	Key V82E		2	
	FL V16 N44			
	Ha	XXXX.X NM		Ha = Apogee altitude.
	Hp	XXXX.X NM		Hp = Perigee altitude.
	TFF	XXBXX MIN-SEC		TFF = Time of free fall to 49.4 NM (300,000 feet).
	Key N50E			
	Splash err	XXXX.X NM		Negative for undershoot, positive for overshoot.
	Hp	XXXX.X NM		
	TFF	XXBXX MIN-SEC		
	KEY REL			
	FL V16 N44			
	Ha	XXXX.X NM		
	Hp	XXXX.X NM		
	TFF	XXBXX MIN-SEC		If TFF = -59B59, TF perigee is available by keying N32E.
	PRO			
	V06 N62			
	VI	XXXXX. FPS		
	H dot	XXXXX. FPS		
	H pad	XXXX.X NM		
	SAFE ORBIT			
	Key V37E 00E			

START	PROCEDURE	PANEL	REMARKS
	2. POSTTRANSLUNAR INJECTION CHECK		
	Monitor LV TK PRESS in 1 hr from orbit insertion to LOW DIVB sep for the following limits LOX > 45 psia (oxid > fuel) FUEL < 45 psia (fuel > oxid) LOW and FUEL TK PRESS < 30 psia	1	Refer to mission rules concerning SIVB fuel and oxidizer tank pressures. Venting after engine cut-off will normally result in LOX tank pressure decrease to ≥32 psia and fuel tank pressure decreasing.
	XXXX

STA/T STEP	PROCEDURE	PANEL	REMARKS
	GMBL MOT (3) - ATT 1/RATE 2	1	START position is momentary. Start SPS gimbal motors sequentially at 1-second intervals to avoid power surge.
	GMBL MOT (4) - START		
	THC - ARMED		
10:[illegible]	THC - neutral & +X		Guarded.
	ΔV THRUST A - NORM		
10:[illegible]	THRUST ON pb - push		SPS ignition.
	THC +X - release		
10:11	ΔV THRUST A - OFF		Guarded.
	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
	3.2.1 Status Checklist		
DP	DC IND sel - FC 3	3	
	DC AMPS ind - monitor amps decr after each No. 2 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC	GMBL MOT P2, Y2 - OFF	1	Shut off gimbal motors sequentially to avoid power surge. Shutdown of No. 2 motors first minimizes switching in servo logic.
DP	DC IND sel - FC 1 or 2	3	
	DC AMPS ind - monitor amps decr after each No. 1 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC	GMBL MOT P1, Y1 - OFF	1	
	cb ELS/CM SM SEP (2) - open	8	
DP	DC IND sel - MNA	3	
	MN BUS TIE (2) - OFF	5	
AC	RHC PWR DIR (both) - OFF	1	

GET & STEP	PROCEDURE	PANEL	REMARKS
	[illegible]	[illegible]	
	[illegible]		
	[illegible]		
	[illegible]		Lever lock.
	[illegible]		Lever lock.
	[illegible]		
	[illegible]	7	
	[illegible]		
00	[illegible]	3	Setting switch to "NORM" removes holding voltage from open side of RC reactant valves.
	[illegible]		
	[illegible]	1	
00	[illegible]	2	Guarded.
	[illegible]		
	[illegible]		
	[illegible]	5	
	[illegible]		PSM heaters.
	[illegible]		
	[illegible]		
00	Remove & stow cb DOCK RING SEP actuation device cb DOCK RING SEP (2) - open (verify)	278	
	WARNING If EPC JETT knob cannot be positioned 180° away from the EPC JETT position before opening side hatch, a pin in the plunger may be sheared possibly allowing press seal to be broken. Cabin repressurization may not be possible due to overboard venting around the EPC plunger.		

STATUS CHECKLIST

START STEP	PROCEDURE	PANEL	REMARKS
	LPA JETT hndl - pull aft & [illegible]	Fwd Hatch	Disarms boost cover hatch release mechanism, preventing BPC JETT plunger from actuating during inflight operation of hatch.
	Rear [illegible] - LATCH (verify)		
	Activ Handle sel - A (neut)		
	Vent piston chamber		
	GN2 handle - pull (inbd)		
	GN2 press ind - min		
LOI	MODE (3) - as desired	9,10,6	
LOI	Crew couch strut unlock lanyards (2) - stow		
	Couch to docking position		
	Rcd V-1 data from ground		This data defines landing site and thrusting parameters for a first orbit, deorbit, and entry.
	Lat_____ Long_____		
	GETI_____ ΔV_____		
3.2.2	SCS Attitude Reference Comparison Check, 8.4.7		Check must be performed as near to orbit injection as possible to prevent additional drift in attitude reference systems.
3.2.3	SCT/SXT Dust Cover Jett Procedure		
	WARNING Until optics are to be used, the OPT ZERO (pnl 122), should be kept at ZERO to prevent inadvertent jett of optics covers.		

NORMAL/BACKUP

START STEP	PROCEDURE	PANEL	REMARKS
		140 260	OPT ZERO - OFF enables function of [illegible] and OPT [illegible] switches.
			Shaft markings for dust cover jettison are OPT = 180 and OPT = 000. The cuter shaft should be rotated and maintained at full rate through these marks until covers are jettisoned.
	ECS Postinsertion Configuration		
	rad leak check ECS RAD sel - PRIM Monitor RAD [illegible] qty for ECS RAD SEL [illegible] - SEC for 10 sec, then OFF	3 377	Provides rapid post-insertion pressure integrity check of secondary radiator circuit - verification system was not opened during boost phase. This does not verify coolant loop heat rejection capability as defined in 5.4.2, step 7.
	ECS RAD sel - PRIM ot PL VENT FLAPS - open	2 8	Prevents inadvertent opening of postlanding vent valves.
	RAD PRESS RELF vlv (2) - NORM (safety latch on)	325	

ECS POSTINSERTION CONFIGURATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		PRIM GLY EVAP STM PRESS ind - 0.09-0.14 psia PRIM GLY EVAP OUT TEMP ind - 38°-43°F Initiate rad flow	2	Water-glycol flow through primary loop radiators to commence no sooner than T +20:00 or later than T +55:00. After 2-1/2 minutes of flow, radiator outlet temperature should be less than inlet temperature.
AC		GLY RSVR BYP vlv - OPEN GLY RSVR OUT vlv - CLOSE GLY RSVR IN vlv - CLOSE	326	
DP		PRIM ACCUM QTY ind - 30-65%	2	
CP,DP		PRIM ACCUM FILL vlv - ON, until 40-55% is reached	379,2	Primary accumulator quantity reading must be increased by at least 5% to provide ullage in glycol reservoir for temperature excursion.
DP		RAD FLOW CONT PWR - PWR	2	
AC		PRIM GLY TO RAD - NORM	325	
DP		RAD PRIM OUT TEMP ind - below RAD PRIM IN TEMP ind	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Outlet temp > than inlet after 5 min		
AC		PRIM GLY TO RAD - BYP (pull), recheck in 10 min	325	ECS primary loop radiators again isolated. In 10 minutes, flow through radiators is attempted once more by repeating procedure.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		DRINK H2O SUP vlv - ON (CCW)	304	
DP		ECS RAD tb - gray	2	Gray indicates No. 1 flow proportioning valve controlling flow.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PDI H2O HTR - AUTO	2	
		GLY EVAP IN TEMP - AUTO		
		cb H2O/URINE DUMP HTR (2) - close	5	
AC		REPRESS PKG vlv - FILL for 10 sec, then OFF	326	
CP		REPRESS O2 PRESS ind - >865 psia	602	
	3.2.5	Systems Verification and Monitoring		
AC	1	Mount ORDEAL BOX Perform ORDEAL Initialization, 8.4.8	13	
	2	Perform C&WS Oper Check, 5.5.1		
	3	Perform SM RCS Mon Check, 5.2.2		
	4	Perform CM RCS Mon Check, 5.2.3		
CP, DP	5	Perform EPS Checks, 5.3.1 thru 5.3.4		
	6	Perform ECS Mon Check, 5.4.1		
DP	7	Perform SPS Mon Check, 5.2.1		
	9	cb COAS/TUNL LTG MNB - close	226	Provides power for COAS, six tunnel lights, and docking spotlight door initiator.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		3.2.6 Cabin Atmosphere Verification		
DP	1	CAB PRESS ind - 5.6-6.2 psia & decr	2	Cabin pressure will be 5.6-6.2 psia after launch and continuously decrease until cabin pressure regulator activates and controls pressure to 4.7-5.3 psia.
AC	2	DIRECT O2 vlv - close (CW)	7	Direct O2 should remain open for at least 3 hours for O2 purge. O2 flow will be 0.7±0.1 lbs/hr during purge.
DP	3	O2 FLOW ind - 0.2 lb/hr	2	
CP	4	EMER CAB PRESS sel - BOTH	351	
	5	SUIT RETURN vlv - open (pull)	380	
ALL	6	Gloves & helmet removed		
CP	7	When CAB PRESS ind <5.3 psia O2 FLOW ind - 1.0 lb/hr O2 FLOW HI lt - on	2	After 16-second time delay.
ALL		MASTER ALARM pb/lt - on, push	1,3,122	
	8	60/40 cab purge complete at 8 hrs		
CP		WASTE STOW VENT vlv - CLOSE	252	
		O2 FLOW HI lt - out	2	

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	4.0 DM INTERFACE		
	4.1 CSM/SLA SEPARATION, TRANSPOSITION AND DOCKING		
	1 The following are req CMC - on, 8.1.3 COAS - installed & calib, 13.1.8 CM Docking Sys Probe Extension & Status Check, 5.7.6 SCS - on, 8.4.2 ISS - on & orient known, 8.1.3 & sec 13 UDAP load & activate, 8.2.1 R1 - 111XX | Noun 46 Disp R2 - X1111 |		Provides G&N control capability. Provides SCS control capability.
	SIVB mnvrs to sep att xxxxxxxxxxxxxxxxxxxxxxxxxxxx If LV GUID sw - CMC Do not reload UDAP Mnvr to sep att R____° P____° Y____° xxxxxxxxxxxxxxxxxxxxxxxxxxxx		Establishes G&N control capability as follows: CSM configuration, 4 quad translation (quads A, B, C, D - on). CSM maneuver should be performed in the following attitude and rate deadbands in either the CMC or SCS control modes to simplify control task during separation.
CP	Key V16N20E (N20) R____° P____° Y____° (N22) R____° P____° Y____° Load N22 (docking att) Pnl configuration per 3.2.1		Postorbital insertion status checklist.

	CMC	SCS
ATT DBD	±0.5° (R03)	±0.2° (MIN)
RATE DBD	+0.2°/sec (fixed)	±0.2°/sec (LO)
RATE CMD (RHC)	+0.5°/sec (R03)	±0.65°/sec

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2 Pnl reconfiguration & sep prep		
J.	Key V60E	2	Nulls FDAI 1 error needles, N17 = N20.
	Key V63E		Permits display of error between present and astronaut loaded gimbal angles on FDAI 1, N20 and N17.
	Verify SM RCS activation		
	SM RCS PRPLNT tb (8) - gray		
	Set pnl 1 SCS att controls		
AS	THC PWR - on (up)	1	Enables direct RCS coils for contingency takeover.
	RHC PWR DIR (both) - MNA/MNB		
	RHC PWR NORM (both) - AC/DC		
	BMAG MODE (3) - RATE 2		Cages the BMAGs and prevents attitude maneuver signals from causing them to hit their stops.
	SC CONT - SCS		
	DBD/RATE - MIN/LO		
	ATT DBD - MIN		
	RATE - LO		
	CMC MODE - FREE		
	LIM CYCLE - OFF		
	LV IND/GPI sw - SIVB (verify)		
	AUTO RCS (16) - MNA or MNB	8	Jets enabled on MN bus A & B should be selected so that command will be maintained for the most critical maneuvers in case of either dc bus failure.
	MAN ATT (3) - RATE CMD	1	Establishes proportional manual control with rate damping for SCS backup
	FDAI SCALE - 5/1		
	TVC SERVO PWR 1 - AC1/MNA	7	
	Establish sep performance cues		
	Perform EMS ΔV Test & Null Bias check, 7.6.1, & EMS ΔV Setup, 7.6.2, except set ΔV ind at -100 to avoid operation around the 0.0 fps settings		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		GDC - align, 8.4.6	7	
		Establish displays		
		FDAI SEL - 1/2	1	Enables G&N on FDAI 1, SCS on FDAI 2.
AC,CP		Key V37E 00E	2	Integrates state vector forward.
AC		EVNT TMR RSET - RSET	1	RSET position is momentary.
		EVNT TMR ind - 00:00		
		cb RCS LOGIC (2) - open	8	Opening these circuit breakers prevents inadvertent direct ullage via THC CCW switches when SECS LOGIC switches on.
	3	Enbl sequencer logic		Provides power to sequencer and pyro circuits for separation.
		cb SECS ARM (2) - close		
		After STDN AOS		
		SECS LOGIC (both) - on (up)		Lever lock.
		Report logic arm		
		After GO from STDN		
		SECS PYRO ARM (2) - on (up)		Lever lock.
		Perform final presep functions		
CP		V66E	2	Transfer CSM state vector to Soyuz (LM) storage.
		Key V37E 47E (thrust monitor)		Permits display of velocity change during thrusting on DSKY. Perform ≈60 seconds prior to separation to minimize effect on PIPA bias.
		FL V16 N83		
		ΔVX, Y, Z (cont) XXXX.X FPS		
AC		RHC 2 - ARMED		
CP		RCS CMD - ON		ON position is momentary. Enables RCS latching relay in SECS. This function also accomplished automatically by SECS.
AC		SC CONT - CMC	1	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		L Separation		
DP		FC REAC VLVS - LATCH	3	
AC		EMS MODE - NORM	1	Perform 30 seconds prior to separation to minimize effective EMS drift.
		CMC MODE - HOLD or AUTO		
		THC - ARMED		
	-00:03	THC - +X & hold 3 sec prior to sep		Initiates preseparation tension.
	00:00	CSM/LV SEP pb - push & hold		Guarded.
		Start Evnt Tmr		
		LV TK PRESS ind (4) - 0		Indicates physical separation.
		LV ENG 1 lt - out		
		CSM/LV SEP pb - rel		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		No sep		
		cb RCS LOGIC (2) - close	8	
		THC - CCW (leave in detent)		Activates automatic SECS separation and direct RCS
	00:00	Evnt Tmr rset & counting up	1	ullage.
		(auto)		
		RCS direct ullage (auto)		SECS delays separation for 3 seconds.
	00:03	LV TK PRESS ind (4) - 0		Indicates physical separation.
		LV ENG 1 lt - out		
	00:07 max	THC - neut		Terminates automatic direct RCS ullage.
		RCS direct ullage terminated (auto)		
		Confirm ΔV =__ fps		Separation velocity is a function of burn time, ≈2.5 seconds of burn per fps.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	00:04 max			
		THC - neut		
		ΔV =-10X.X fps		Separation velocity is a function of burn time, ≈2.5 seconds of burn per fps.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5	Postsep pnl configuration		During coast to transposition. Provides normal, safe, formation flight configuration.
		Verify SM RCS tb position		
CP		SM RCS QUAD He tb (4) - gray	2	
		SM RCS QUAD PRPLNT tb (8) - gray		
		SM RCS PSM PRPLNT tb (4) - bp		
		PSM He tb - bp		
		PSM MANF ISOL tb - gray		
		SM RCS QUAD SEC FUEL PRESS (4) - OPEN		
DP		FC REAC VLVS - NORM	3	
CP	6	Transposition		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If propulsive venting not inhibited		If propulsive venting not inhibited, minimum separation distance at completion of pitch maneuver will be ≈65 feet.
		Do NOT perform -X trans at 00:35		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC				
00:35		THC -X to ΔV = -100.3 fps		
		MAN ATT PITCH - ACCEL CMD	1	
		RHC - pitch up ≈2°/sec		Positive pitch at 2°/second followed by a negative pitch command to null rates at a total pitch maneuver of 180°. At completion of pitch maneuver, minimum separation distance will be ≈55 feet.
		Visually acq SIVB & null pitch rate		
CP		V62E	2	Permits display of error between present and docking attitude on FDAI 1, N20 and N22.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		MAN ATT PITCH - RATE CMD RHC, THC - Null trans errors & rates Key V49E, 8.3.4 Perform auto mnvr to docking att	1	
	or	Perform man mnvr to docking att CMC MODE - FREE RHC - null error needles		
	7	Set pnl 1 SCS att controls CMC MODE - FREE (verify) BMAG MODE (3) - ATT 1/RATE 2 SC CONT - SCS		
	8	Verify control status for docking COAS PWR - on (up)	15	
CP		EXT RNDZ LTS - SPOT	274	
	9	PROBE EXTD/REL - RETR (verify) PROBE EXTD/REL tb (2) - gray (verify)	2	Guarded. Verifies capture latches not locked.
	10	Initiate capture latch		
AC		THC - translate to close at 0.25 to 0.5 fps maintain min lateral velocity RHC - maintain min relative align angles with SIVB At contact, apply +X thrust as req		Rate established visually. Use COAS and docking target for alignment cues. Contact will be indicated by audio cues, a slight disturbance in motion, and/or COAS observation.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PROBE EXTD/REL tb (2) - bp		Talkbacks barber pole indicate capture. Only one talkback required for indication. Failure to capture will also be indicated by no noticeable rebound tension load (deceleration) and separation from SIVB. If retraction initiated, it will not occur until capture.
AC		SC CONT - CMC	1	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Positive indication of no capture		
		(Backup 1)		
		SC CONT - SCS (verify)		
		THC - (-)X, withdraw to formation flight distance		
		PROBE EXTD/REL - EXTD/REL for 5 sec	2	Guarded. EXTD/REL position is momentary.
		PROBE EXTD/REL - RETR		Guarded.
		PROBE EXTD/REL tb - gray (verify)		
		ATTEMPT redocking as before or perform redocking with backup 2 procedure		
		(Backup 2)		
		SC CONT - SCS (verify)	1	
		THC - (-)X, withdraw to formation flight distance		
		ATTEMPT redocking as before and place PROBE EXTD/REL - EXTD/REL (HOLD) during final phase prior to contact. After contact with +X applied and probe in drogue, place PROBE EXTD/REL - RETR	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Probe auxiliary retract method		The probe auxiliary retract method bypasses the normal retract circuit.
AC		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (2) - OFF		Lever lock.
		cb SECS ARM (2) - OPEN		
		THC - LOCKED		
		RHC - LOCKED		
		UTIL PWR - OFF (verify)	15	
		Remove UTIL pwr receptacle cap		Cap tethered.
		Remove LDEC access pnl (aft of pnl 276)		E tool. LDEC (Lunar Docking Event Controller).
		Remove LDEC receptacle J5 cap (fwd LDEC)		Cap tethered.
		Remove aux dump nozzle htr cable from stowage		For stowage, reference NASA-S-74-517. Cable length 108 inches.
		Remove docking probe aux harness cable		Cable length 12 inches.
		Connect cables together		
		Connect cable between UTIL pwr receptacle and J5 receptacle of fwd LDEC		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		THC - UNLOCKED RHC - UNLOCKED Repeat docking approach at ≈0.10 fps RHC - maintain min relative align angles with SIVB At contact, apply +X until hard dock or 10 sec max UTIL PWR - on (up) while thrusting UTIL PWR - OFF, after hard dock	15	Probe retracts.
		Allow probe to damp SC motions (≈10 sec) THC - null pitch & yaw align error to within ±3° (min poss rates & misalign)		Alignment determined using COAS and docking target. Retraction loads may cause docking ring damage. Loads are minimum at zero misalignment during retraction.
		RHC - null roll align error to within ±10°		Docking with roll angles >±10° may prohibit CM/DM umbilical connection.
	11	Initiate retraction & docking latch closure PROBE RETR PRIM - 1 Observe retraction movement between the two vehicles PROBE EXTD/REL tb (2) - gray	2	When capture latch alignment satisfactory. 10-inch retraction stroke should take ≈10 seconds. Talkback A will indicate only if docking latches 1, 5, and 9 close. Talkback B will indicate only if latches 3, 7, and 11 close. Audio and tactile cues will also indicate docking latch closure.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		PROBE EXTD/REL tb (2) - remain bp after 30 sec & docking latch closure cues (auditory & tactile) unsatisfactory PROBE RETR PRIM - 2 If docking still unsuccessful PROBE RETR SEC - 1	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	12	Safe docking sys		
AC		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		cb SECS ARM (2) - open	7	
		EDS PWR - OFF	8	
		cb EDS (all) - open	2	Guarded.
CP		PROBE EXTD/REL - OFF		
		PROBE RETR (2) - OFF	8	
AC		cb DOCK PROBE (2) - open		
	13	Postdocking pnl configuration	1	
		RATE - HI		
		ATT DBD - MAX	8	If backup method separation is used (THC - CCW), RCS LOGIC circuit breakers will still be closed so that direct ullage will be activated. In this case it is not desirable to open these circuit breakers until after maneuvering is completed.
		cb RCS LOGIC (2) - open (verify)		
AC		TVC SERVO PWR (2) - OFF	7	
CP		EXT RNDZ LTS - off (ctr)	274	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PRO	2	
		FL V37		
		Key 00E		
AC		COAS PWR - OFF	15	
		EMS MODE - SCRY	1	
		EMS FUNC - OFF		
		ENAG MODE (3) - RATE 2		
		Key V82E	2	Checks state vector.
		Key V47E		Moves Soyuz (LM) state vector into CSM state vector.
	4.2	PREPARATION FOR DM EJECTION		
ALL	1	Configure PGAs, 5.4.6b		
CP		Retrieve & don helmet protective shield		
	2	Configure couches as req		
	3	Configure control pnl		
DP		cb DM PWR (2) - open (verify)	274	
		cb DM FURNACE/CRYSTAL GROWTH (3) - open (verify)		
		TUNL LTS - on (up)		
	4	Perform docking tunl operations		
		CM/DM tunl press equalization & integrity check		
		TUNL VENT vlv - DM/CM ΔP	12	
		DM/CM ΔP ind - (-)4.0 psid (pegged)		
		PRESS EQUAL vlv - OPEN	Fwd hatch	
		DM/CM ΔP ind - 0.0 psid		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	TUNL VENT vlv - DM PRESS, for ≈15 min.	12	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	PRESS EQUAL VLV - CLOSE	Fwd hatch 12	
	Monitor DM/CM ΔP ind for 2 min & verify ΔP stable		
	PRESS EQUAL VLV - OPEN	Fwd hatch tunl	
	Remove fwd hatch, 5.7.1		A minimum of nine good docking ring latches required for any CSM/DM SPS burns.
	Verify docking latches		Latch indicator button (red) may protrude through hole in latch handle if latch is not engaged.
	Pull latch handle of each latch to ensure hook is engaged		
	Pwr bungee parallel to +X axis (verify)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	If hook(s) not engaged		
	Attempt to engage latch handle prior to recocking latch		
	If pwr bungee not parallel to +X axis		
	Push on top of bungee fairing to obtain final preload		
	If hook(s) cannot be engaged or pwr bungee parallel to +X axis not attained		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Recock latch(es) & man trigger, 5.7.10 steps 2 & 4	tunl	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Verify probe extend latch engaged - indicator (RED) not visible		
		Depress GN2 bleed button (red) at aft end of probe body & hold for 10 sec		Required to bleed probe retract gas system for subsequent operation.
		Disconnect both docking probe connectors (yellow) and install in probe stowage receptacles		
		Connect DM umb conn (4) as follows & per following chart		
		P23 to J23 (orange to orange)		
		P24 to J24 (orange to orange)		
		P27 to J27 (yellow to yellow)		
		P28 to J28 (yellow to yellow)		
		Disengage conn from stowage receptacle in DM tunl		One at a time.
		Pull umb across docking interface		
		Align index marks		
		Push DM umb conn into receptacle in CM docking ring & rot CW to lock		
		Route DM umb thru slot in back of receptacle assy & close fairing (orange)		Fairing must be closed to install hatch.
		Repeat according to chart for remaining 3 umbs		
		Reinstall fwd hatch, 5.7.2		
DP		TUNL LTS - OFF	274	
ALL	5	Reconfigure couches as req		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	4.3	DM EJECTION FROM SLA		
	1	The following are req CMC - on, 8.1.3 SCS - on, 8.4.2 ISS - on & orientation known, 8.1.3 & sec 13 RCS DAP load & activated, 8.2.1		
		R1 - 61102 | Noun 46 disp R2 - X1111 |		
		R1 - XXXXX | Noun 47 disp R2 - 00000 |		N47 R1 = combined CSM + DM weight.
	2	Pre-DM ejection		
AC		Set Evnt Tmr 00:00	1	
		cb SECS ARM (2) - close	8	
		After STDN AOS SECS LOGIC (both) - on (up) Report logic arm		Lever lock.
		After GO from STDN SECS PYRO ARM (2) - on (up) STDN verify pyro buses armed		Lever lock.
	3	Perform ejection		
		TVC SERVO PWR 1 - AC1/MNA	7	
		EMS FUNC - ΔV SET	1	
		SLEW ΔV ind - +100.0 EMS FUNC - ΔV EMS MODE - NORM		Perform ≈30 seconds prior to ejection to minimize EMS drift error.
DP		cb SIVB/DM SEP (2) - close (verify)	274	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION cb SIVB/DM SEP (2) are to be closed before operating SIVB/DM SEP switches to on (up) position. If not, SIVB/DM SEP will not occur.	274	
00:00		SIVB/DM SEP - on (up) Start Evnt Tmr	2	Guarded. On (up) position is momentary. Spring system will provide a minimum separation velocity of TBD fps (assumes four actuators operated).
AC 00:05 00:08		THC -X & hold THC - neut		Provides a minimum separation velocity of TBD fps: or TBD fps if propulsive venting is not inhibited. The following tables provide parameters for flight planning if the variables (SIVB propulsive vent, time of RCS burn, etc.) are changed for specific missions. (See figure 4-1.)
00:14		CMC MODE - AUTO	1	
	4.	Postejection SECS PYRO ARM (2) - SAFE SECS LOGIC (both) - OFF cb SECS ARM (2) - open	8	Lever lock. Lever lock.
DP		cb SIVB/DM SEP (2) - open	274	
AC		LV IND/GPI sw - GPI CMC MODE - FREE MAN ATT (3) - MIN IMP SC CONT - SCS	1	When clear of SIVB.
CP		Reload DAP N46, R1 = 61111	2	

3 Sec CSM RCS Burn (400 Lb -X Translation)				
Configuration	SIVB Propulsive Vent Force (lbs)	Time to Translate 15 Ft (seconds)		SIVB and CSM Recontact Time (No Evasive Mnvr)
		RCS Burn at 5.0 to 8.0 Sec After Sep	RCS Burn at 8.0 to 11.0 Sec After Sep	
DM Ejection In Earth Parking Orbit	TBD	TBD	TBD	TBD

No CSM RCS -X Translation			
Configuration	SIVB Propulsive Vent Force (lbs)	Time to Translate 15 Ft (secs)	SIVB and CSM Recontact Time (No Evasive Mnvr)
		No RCS Burn	
DM Ejection In Earth Parking Orbit	TBD	TBD	TBD

Figure 4-1. SIVB/CSM Separation Parameters

DM EJECTION FROM SLA

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		EMS MODE - STBY EMS FUNC - OFF THC PWR - OFF RHC PWR DIR (both) - OFF RHC, THC - LOCKED	1	
		TVC SERVO PWR (2) - OFF	7	
	5	Verify DM passive mode		Docking mechanism was configured to passive mode during prelaunch. This check verified passive mode prior to predocking operations and verifies integrity of umbilical connections. Convention for passive mode configuration dictates that structural latches are open as well as docking mechanism being in passive mode. Refer to Figure 10-1 for docking system status light logic.
		System A		
DP		cb DS A IND LOGIC MNA - close cb DS A IND PWR AC1 - close cb DM POWER (2) - close	274	DM wall heaters, fan, lights and instrumentation.
CP		STRUCT LATCH OPEN lt - on	2	Structure latches should be fully open.
		PASSIVE lt - on		PASSIVE lt on (passive mode) requires BACKUP (passive) Hooks at RESET (closed), Body Latches closed, and Guide Ring fully retracted.
DP		cb DS A IND LOGIC MNA - open cb DS A IND PWR AC1 - open	274	
		System B		Conditions same as for System A.
		cb DS B IND LOGIC MNB - close cb DS B IND PWR AC2 - close		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	STRUCT LATCH OPEN lt - on PASSIVE lt - on	2	
DP	cb DS B IND LOGIC MNB - open cb DS B IND PWR AC2 - open	274	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	One or both lts not on NOTIFY STDN		State of all (6) docking system status lights communicated to STDN via TLM.
	If STDN verifies lts on condition, continue nominal operations (STDN confirms configuration state in lieu of on-board status lts)		
	If STDN confirms lts not on Recycle system		Recycling system may correct an intermittant condition, caused by launch dynamics, that prevents positive status light verification of passive mode.
	cb DS IND LOGIC (2) - close cb DS IND PWR (2) - close cb DS CONTROL BAT (2) - close cb DS MOTORS AC1 (3) - close cb DS MOTORS AC2 (3) - close		
	No STRUCT LATCH OPEN lt		
CP	STRUCT LATCH (A) - CLOSE STRUCT LATCH CLOSE lt - on	2	System A only.
	STRUCT LATCH (A) - OPEN STRUCT LATCH CLOSE lt - out		Guarded.
	STRUCT LATCH OPEN lt - on STRUCT LATCH (A) - off (ctr)		Guarded.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If still no lt Exercise System B		
CP	STRUCT LATCH B - CLOSE	2	System B only.
	STRUCT LATCH CLOSE lt - on		
	STRUCT LATCH B - OPEN		Guarded.
	STRUCT LATCH CLOSE lt - out		
	STRUCT LATCH OPEN lt - on		
	STRUCT LATCH B - off (ctr)		Guarded.
	If still no lt		
	CAUTION		
	STRUCT LATCH - CLOSE must be oper by sys A or B only (single mtr). Stalled gear box load using two mtrs could exceed sys cable breaking strength.		Gear box loads not excessive when opening structural latches.
	Exercise both sys (A & B) simultaneously		
	No PASSIVE lt Perform dock sys passive test (sys A & B), 18.4.7		This operation may necessitate access to DM earlier than planned. This test helps isolate cause of passive light failure before actually exercising backup passive system.
	Remove Fwd hatch, 5.7.1 (stow) Remove docking probe & drogue, 5.7.4 & 5.7.7 (stow)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Perform Dock Mod Press Inter ck, 18.3.1		
	Perform DM Press, 18.3.2 (steps 1 thru 3)		
DP	LIGHTING 2 - ON	215	Located in DM.
CP	BACKUP PASSIVE (2) - RELEASE	2	
	BACKUP PASSIVE (2) - RESET		
	BACKUP PASSIVE (2) - off (ctr)		Guarded.
	PASSIVE lt still not on		
	CAUTION GUIDE RING - EXTD/RETR must be oper on sys A or B only (single mtr). Dynamic forces using two mtrs could create loads in struct beyond design limit.		
	GUIDE RING (A) - EXTD		System A only.
	GUIDE RING EXTEND lt - on		
	GUIDE RING (A) - RETR		
	GUIDE RING EXTEND lt - out		
	GUIDE RING (A) - off (ctr)		
	PASSIVE lt still not on		
	GUIDE RING B - EXTD		System B only.
	GUIDE RING EXTEND lt - on		
	GUIDE RING B - RETR		
	GUIDE RING EXTEND lt - out		
	GUIDE RING B - off (ctr)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If still no lt, bypass GUIDE RING limit sw's, or go to malf TBD		
DP	LIGHTING 2 - START	815	
	Remove CM O2 hoses from DM (stow in CM)		
	Close DM hatch 2, 18.6.1 (step 3)		Timeline may determine that DM should not be closed out.
	Install fwd hatch, 5.7.2		
	cb DS IND LOGIC (2) - open	274	
	cb DS IND PWR (2) - open		
	cb DS CONTROL BAT (2) - open		
	cb DS MOTORS AC1 (3) - open		
	cb DS MOTORS AC2 (3) - open		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Guide ring limit sw bypass		Bypass switches located in DM. Opening of hatches 1 and 2 and entry into DM earlier than planned may be required.
	If GUIDE RING sw will not operate guide ring on sys A or B		
	CAUTION AC motor limit sw's bypassed. To prevent possible ac motor damage, do not exceed _____ seconds with GUIDE RING sw at EXTD or RETR position.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Remove Fwd hatch, 5.7.1 (stow) Remove docking probe & drogue, 5.7.4 & 5.7.7 (stow) Perform Dock Mod Press Integ ck, 18.3.1 Perform DM Press, 18.3.2 (steps 1 thru 3)		
DP		**LIGHTING 2 - ON**	815	Located in DM.
		GUIDE RING EXTD LIMIT SW - BYPASS	862	Guarded. Located in DM.
		cb DS IND LOGIC (2) - close (verify)	274	
		cb DS IND PWR (2) - close (verify)		
		cb DS CONTROL BAT (2) - close (verify)		
		cb DS MOTORS AC1 (3) - close (verify)		
		cb DS MOTORS AC2 (3) - close (verify)		
		CAUTION GUIDE RING - EXTD/RETR must be oper on sys A or B only (single mtr). Dynamic forces using two mtrs could create loads in struct beyond design limit.		
		To Extend		
CP		**GUIDE RING A(B) - EXTD**	2	
		PASSIVE lt - out		
		GUIDE RING EXTEND lt - on		
		STUCT LATCH OPEN lt - on		
		GUIDE RING A(B) - off (ctr)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		To Retract		
DP		GUIDE RING RETR LIMIT SW - BYPASS	862	Guarded.
CP		GUIDE RING A(B) - RETR	2	
		GUIDE RING EXTEND lt - out		
		STRUCT LATCH OPEN lt - on		
		When full retract		
		PASSIVE lt - on		
		GUIDE RING A(B) - off (ctr)		
DP		GUIDE RING LIMIT SW (2) - NORMAL	862	Guarded.
		LIGHTING 2 - START	815	
		Remove CM O2 hoses from DM (stow in CM)		
		Close DM hatch 2, 18.6.1 (step 3)		Timeline may determine that DM should not be closed out.
		Install fwd hatch, 5.7.2		
		cb DS IND LOGIC (2) - open	274	
		cb DS IND PWR (2) - open		
		cb DS CONTROL BAT (2) - open		
		cb DS MOTORS AC1 (3) - open		
		cb DS MOTORS AC2 (3) - open		
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
	4.4	DM JETTISON AND SEPARATION		
	1	Key VHOE, 8.3.4		
		Perform auto mnvr to jett att		R62.
or		Perform SCS att mnvr to jett att, 8.4.5		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	DM Jett Config, 18.4.4		
	3	Perform fwd hatch seal integrity check, 5.7.3		
	4	Perform DM jett prep		
CP		cb DM PMP (2) - open (verify)	274	
		cb DM FURNACE/CRYSTAL GROWTH (3) - open (verify)		
AC		cb SECS ARM (2) - close	8	
		After SIDM AOS		
		SECS LOGIC (both) - on (up)		Lever lock.
		Report logic arm		
		After GC from SIDM		
		SECS PYRO ARM (2) - on (up)		Lever lock.
		At jett att		
		BMAG MODE (3) - ATT 1/RATE 2	1	
		SC CONT - SCS		
CP		RCS DAP - load & activate, 8.2.1		
		R1-11102 | R2-X1111 | R46 display	2	
		Key V37E 47E (thrust monitor)		P47 should be called just prior to DM jettison to keep IMU compensation and average G computation errors at a minimum.
	5	DM Jett		
DF		cb DOCK RING SEP (2) - close	278	
CP		DOCK RING SEP (both) - on (up)	2	Guarded and momentary. Provides jettison of docking ring, with probe and DM attached, from CSM. Separation velocity of TBD ft/sec will be obtained with the use of the docking ring pyrotechnic separation device only (CM/DM tunnel depressurized). If four quads RCS firing is used to augment ΔV, TBD pounds of propellants are used for every second of firing. Any pressure in CM/DM tunnel at time of separation will impart an additional ΔV up to a maximum of TBD ft/sec.

DM JETTISON AND SEPARATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	6	Postjett pnl reconfiguration		
AC		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		cb SECS ARM (2) - open		
	7	Separation		
		Perform SCS att mnvr to sep att, 8.4.5		
or		Perform auto mnvr to sep att, 8.3.4		
		Monitor G&N thrusting, 8.1.6		
		EMS MODE - NORM	1	
		THC - +Z (2 jet) for 1.0 fps ΔV		
		(5 sec min after pyro sep)		
	4.5	PRE-DOCKING DM CHECKOUT		
	1	Tunnel 1 Press Integ ck & Equalization		
		TUNL VENT - DM/CM ΔP (verify)	12	
		DM/CM ΔP ind - ≤ (±) 1 psid (verify)		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If ΔP > (-1) psid (tunl leaked), or if		
		ΔP > (+1) psid (DM leaked into tunl)		
		PRESS EQUAL vlv - OPEN (until	Fwd	
		DM/CM ΔP ind = 0 psid)	Hatch	
		PRESS EQUAL vlv - close		
		DM/CM ΔP ind - monitor (2 min)	12	
		for stability		
		If not stable		
		Report to STDN		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		PRESS EQUAL vlv - OPEN (CCW)/lock	Fwd Hatch	
	2	Remove Stow Fwd Hatch/Probe/Drogue		
		Remove Fwd Hatch, 5.7.1 (stow)		
		Remove Probe, 5.7.6 (stow)		
		Remove Drogue, 5.7.7 (stow)		
		TUNL PRESS RELIEF vlv - capped		
	3	Perform DM Press Integ ck, 18.3.1		
	4	Perform DM Press, 18.3.2		
	5	Perform C/W ck, 18.4.2		
	6	Config Telecom, 18.5		
	7	Perform following		
DP		HHAG - Unstow & mount in HIGH PRESS RELIEF vlv recess	821	
CP		Initiate CM DSE		
		TAPE RCDR - RCD, FWD, CMD RESET	3	
DP		Check DM systems (voice rcd ind's)		
		N2 TANK QTY (both) - >71%	815	
		O2 TANK QTY (both) - >80%		
		CABIN PRESS ind - 243-274 mmHg		
		Verify HHAG calib with pnl ind		
		CABIN TEMP ind - 13-27°C		
		O2 PART PRESS ind (2) - ≥165 mmHg		
		CO2 PART PRESS ind - <7.6 mmHg		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	8	Transfer equip		Equipment to be transferred from DM into CM.
CP/ DP	9	Perform TV Install and ckout, 18.5.2		
	10	Perform Furnace (MA-010) prep, 17.9		
	4.6	CSM UNDOCKING FROM DM		Provides procedure for CSM/DM separation in lieu of DM Jettison.
	1	Verify CSM/DM pwr interface deactivated UVA drag-thru cable removed, 17.6.7		
DP		cb DM FURNACE/CRYSTAL GROWTH (3) - open	274	
		cb DM PWR (2) - open		
		cb DS A (6) - open		
		cb DS B (6) - open		
		cb DOCK PROBE (2) - open	8	
ALL	2	All crewmen transfer to CSM		
	3	Perform prep for CSM/DM sep		
DP		TUNL LTS - on (up)	274	
		Disconnect & stow DM umb conn (4)		
		Install docking drogue & probe, 5.7.8 & 5.7.5		
		Preload probe & disengage docking latches, 5.7.9 & 5.7.10		
		Perform fwd hatch seal integrity ck, 5.7.3		
		TUNL LTS - OFF (verify)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	4	Perform sys prep		
		SCS - on, 8.4.2		
		UDMP - load & activate, 8.2.1		
AC		cb A/C POLL, B/D ROLL, P, Y (8) - close (verify)	8	
		Select desired displays, 7.2		
		Select Att control, 7.1		
		MAN ATT (3) - RATE CTD	1	
		DBD/RATE - MIN/HI		
		ATT DBD - MIN		
		RATE - HI		
		THC PWR - on (up)		
		RHC PWR NOPN (both) - AC/DC		
		RHC PWR DIP (both) - MNA/MNB		
		AUTO RCS (16) - MNA/MNB		
		SC cont - CMC/AUTO		
		SC CONT - CMC		
		CMC MODE - AUTO		
		RHAG MODE (3) - RATE 2		
		ΔV Setup, 7.6.2		
		Set ΔV ind +100.0 fps		
		cb DOCK PROBE (2) - close	8	
CP		PROBE EXTD/RTL - RETR	2	Guarded.
		PROBE EXTD/RTL tb (2) - bp (verify)		Verifies redundant probe retract capability.
		PROBE EXTD/RTL - OFF		Guarded.
		SPOT LIGHT - ON		
	5	Perform fnl prep and oper		
AC		Set Event Timers		Timer will be set up to read 00:00 at separation.
		EVENT TIMER PSHT - DOWN	1	
CDR/PLT		EVENT TIMER START - START (on signal from AC)		START position is momentary. Timer started by CP.
		RMS MODE - NOPN		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	6	SM RCS thrusting prep		
CP		SM RCS QUAD PRI PRPLNT (4) - OPEN	2	
		SM RCS QUAD PRI PRPLNT tb (4) - gray		
		SM RCS QUAD SEC PRPLNT tb (4) - gray		
		SM RCS PSM PRPLNT (4) - CLOSE		
		SM RCS PSM PRPLNT tb (4) - bp		
		SM RCS PSM He - CLOSE		
		PSM He tb - bp		
		SM RCS PSM MANF ISOL - CLOSE		
		PSM MANF ISOL tb - bp		
		RCS IND sel - SM D (verify)		
		RCS IND sw - TK PRESS/QTY (verify)		
	7	Undocking/Separation		AC will count down to separation time.
00:00		PROBE EXTD/REL - EXTD/REL & hold for DM sep +5 sec		Guarded. EXTD/REL position is momentary. Probe extended by a compression spring and attenuator airhead forces.
		PROBE EXTD/REL tb (2) - gray to bp to gray		Barber pole indicates power to talkback through probe circuitry. Return to gray indicates full extension of probe.
		Monitor DM sep		AC will monitor DM separation.
		SPOT LIGHT - OFF		

5.0 SYSTEMS MANAGEMENT

Systems management is a compilation of data and procedures that are common to more than one mission phase. The procedures involve system monitoring, periodic checks, and unique functions of the following systems only: SPS, RCS, EPS, ECS, C&WS, T/C and Mechanical. Systems integrated procedures for prelaunch through postlanding phases will repeatedly reference material contained in systems management.

5.1 GENERAL DATA

This paragraph contains information of a general nature that closely relates with Systems Management procedures.

5.1.1 Systems Test Indicator Readouts

A SYS TEST indicator and two selector switches (panel 101) provide the crew with the capability of monitoring some systems measurements telemetered to STDN. A chart (figure 5-1) for converting the SYS TEST indicator readings to measurement parameters is included in this paragraph. Measurements consist of the following:

- Fuel cells 1, 2, and 3 regulated N2, O2, and H2 pressures
- O2 tank 1 and 2 heater temperatures
- Fuel cells 1, 2, and 3 radiator outlet temperatures
- DM O2 tank 1 and 2 quantity
- DM N2 tank 1 and 2 quantity
- DM O2 partial pressure
- DM cabin press
- SM RCS reserve [propellant storage module (PSM 1)] fuel tank temperatures
- UV exp pointing error
- Battery compartment manifold pressure
- Battery relay bus voltage
- SPS engine valve body oxidizer feed line, SPS fuel check valve temperatures
- CM/RCS engine jet oxidizer valve temperature

The systems test indicator conversion chart (figure 5-1) lists positions of the SYS TEST switches (2), and pertinent data available for each indicator readout.

SYSTEMS TEST INDICATOR READOUTS

NORMAL/BACKUP

SYS TEST Sel Sw (2)	SYS TEST Ind				
	System			Nominal Range	
Position	Function	Measurement No.	Sensor Range	System	Display (volts)
1A	FC 1 N2 PRESS	SC 2060 P	Zero/75 psia	50 - 58 psia	3.3 - 3.9
2A	FC 1 02 PRESS	SC 2066 P	Zero/75 psia	58 - 69 psia	3.9 - 4.6
3A	FC 1 H2 PRESS	SC 2069 P	Zero/75 psia	57 - 67 psia	3.8 - 4.5
4A	FC 1 RAD OUT TEMP	SC 2087 T	-50/+300°F	-10 - +90°F	0.6 - 2.0
5A	FC 3 N2 PRESS	SC 2062 P	Zero/75 psia	50 - 58 psia	3.3 - 3.9
6A	FC 3 02 PRESS	SC 2068 P	Zero/75 psia	58 - 69 psia	3.9 - 4.6
7A	FC 3 H2 PRESS	SC 2071 P	Zero/75 psia	57 - 67 psia	3.8 - 4.5
8A	FC 3 RAD OUT TEMP	SC 2089 T	-50/+300°F	-10 - +90°F	0.6 - 2.0
9A	FC 2 N2 PRESS	SC 2061 P	Zero/75 psia	50 - 58 psia	3.3 - 3.9
10A	FC 2 02 PRESS	SC 2067 P	Zero/75 psia	58 - 69 psia	3.9 - 4.6
11A	FC 2 H2 PRESS	SC 2070 P	Zero/75 psia	57 - 67 psia	3.8 - 4.5
1B	FC 2 RAD OUT TEMP	SC 2088 T	-50/+300°F	-10 - +90°F	0.6 - 2.0
2B	BAT COMPT PRESS	CC 0188 P	Zero/20 psia	<9 psia	<2.3
3B	BAT RELAY BUS VOLT	CC 0232 V	Zero/45 vdc	30.5 - 37.0 vdc	3.4 - 4.1
4B	CM RCS ENG 12 VLV TEMP	CR 9001 T	-50/+250°F	>40°F	>1.5
5B	CM RCS ENG 14 VLV TEMP	CR 9002 T	-50/+250°F	>40°F	>1.5
6B	CM RCS ENG 16 VLV TEMP	CR 9003 T	-50/+250°F	>40°F	>1.5
7B	CM RCS ENG 21 VLV TEMP	CR 9101 T	-50/+250°F	>40°F	>1.5
8B	CM RCS ENG 23 VLV TEMP	CR 9102 T	-50/+250°F	>40°F	>1.5
9B	CM RCS ENG 25 VLV TEMP	CR 9103 T	-50/+250°F	>40°F	>1.5

Figure 5-1. Systems Test Indicator Conversion Chart (Sheet 1 of 4)

SYSTEMS TEST INDICATOR READOUTS

SYS TEST Sel Sw (2)	SYS TEST Ind				
	System			Nominal Range	
Position	Function	Measurement No.	Sensor Range	System	Display (volts)
10B	SM RCS PSM 1 FUEL TK TEMP	SR 9809 T	0/+150°F	+30 - 105°F	1.0 - 3.5
11B	N/A	N/A	N/A	N/A	N/A
1C	SM RCS A PRIM FUEL TK TEMP	SR 5073 T	0/+150°F	+30 - +110°F	1.0 - 3.7
2C	SM RCS B PRIM FUEL TK TEMP	SR 5075 T	0/+150°F	+30 - +110°F	1.0 - 3.7
3C	SM RCS C PRIM FUEL TK TEMP	SR 5075 T	0/+150°F	+30 - +110°F	1.0 - 3.7
4C	SM RCS D PRIM FUEL TK TEMP	SR 5076 T	0/+150°F	+30 - +110°F	1.0 - 3.7
5C	SPS ENG VLV BODY FUEL TEMP	SP 9020 T	0/+150°F	+40 - +150°F	1.3 - 5.0
6C	SPS OXID FEED LINE TEMP	SP 9016 T	0/+150°F	+40 - +110°F	1.3 - 3.7
7C	SPS FUEL CHK VLV TEMP	SP 9018 T	0/+150°F	+40 - +110°F	1.3 - 3.7
8C	SPS OXID TK OUTBD TEMP	SP 9014 T	0/+150°F	+40 - +110°F	1.3 - 3.7
9C	N/A	N/A	N/A	N/A	N/A
10C	CRYO 02 TK1 HTR TEMP	SC 0070 T	-300/+600°F	<350°F	>3.6
11C	CRYO 02 TK2 HTR TEMP	SC 0071 T	-300/+600°F	<350°F	>3.6
1D	DM 02 PPA	DF 9615 P	0 - 500 mm Hg	<150 mm Hg	>1.5
1E	DM 02 PPB	DF 9616 P	0 - 500 mm Hg	<150 mm Hg	>1.5
1F	DM 02 TK 1 QTY	DF 9632 Q	0 - 100%	0 - 100%	0.0 - 5.0
1G	DM 02 TK 2 QTY	DF 9637 Q	0 - 100%	0 - 100%	0.0 - 5.0
1H	DM N2 TK 1 QTY	DF 9652 Q	0 - 100%	0 - 100%	0.0 - 5.0
1J	DM N2 TK 2 QTY	DF 9657 Q	0 - 100%	0 - 100%	0.0 - 5.0
1K	DM CABIN PRESS	DF 9605 P	0 - 880 mm Hg	250 - 550 mm Hg	0.9 - 3.1
1L	UV EXP POINTING ERROR	DL 9666 Y	-1.5°/+1.5°	-0.3/+0.3	2.0 - 3.0
2D thru 11 I	N/A	N/A	N/A	N/A	N/A

Figure 5-1. Systems Test Indicator Conversion Chart (Sheet 1 of 4)

SYS TEST Indicator Display	Reg Press. (psia) N2	O2	H2	EPS Rad Out Temp (°F)	Bat Compt Manf (psia)	Bat Rly Bus (vdc)	SM RCS PSM Fuel Tk (°F)	SM RCS Prim Fuel Tk (°F)	CM RCS Eng Vlv (°F)	SPS Eng Vlv Body (°F)	SPS Oxid-Feed Line, Fuel Ck Vlv, Oxid Tk Otbd (°F)	O2 Tk Htr Temp (°F)
0.0	0	0	0	-50	0.00	0.0	0.0	0.0	-50	0.0	0.0	-300
0.2	3	3	3	-36	0.80	1.8	6.0	6.0	-38	6.0	6.0	-264
0.4	6	6	6	-22	1.60	3.6	12.0	12.0	-26	12.0	12.0	-228
0.6	9	9	9	-8	2.40	5.4	18.0	18.0	-14	18.0	18.0	-192
0.8	12	12	12	+6	3.20	7.2	24.0	24.0	-02	24.0	24.0	-156
1.0	15	15	15	+20	4.00	9.0	30.0	30.0	+10	30.0	30.0	-120
1.2	18	18	18	+34	4.80	10.8	36.0	36.0	+22	36.0	36.0	-84
1.4	21	21	21	+48	5.60	12.6	42.0	42.0	+34	42.0	42.0	-48
1.6	24	24	24	+62	6.40	14.4	48.0	48.0	+46	48.0	48.0	-12
1.8	27	27	27	+76	7.20	16.2	54.0	54.0	+58	54.0	54.0	+24
2.0	30	30	30	+90	8.00	18.0	60.0	60.0	+70	60.0	60.0	+60
2.2	33	33	33	+104	8.80	19.8	66.0	66.0	+82	66.0	66.0	+96
2.4	36	36	36	+118	9.60	21.6	72.0	72.0	+94	72.0	72.0	+132
2.6	39	39	39	+132	10.40	23.4	78.0	78.0	+106	78.0	78.0	+168
2.8	42	42	42	+146	11.20	25.2	84.0	84.0	+118	84.0	84.0	+204
3.0	45	45	45	+160	12.00	27.0	90.0	90.0	+130	90.0	90.0	+240
3.2	48	48	48	+174	12.80	28.8	96.0	96.0	+142	96.0	96.0	+276
3.4	51	51	51	+188	13.60	30.6	102.0	102.0	+154	102.0	102.0	+312
3.6	54	54	54	+202	14.40	32.4	108.0	108.0	+166	108.0	108.0	+348
3.8	57	57	57	+216	15.20	34.2	114.0	114.0	+178	114.0	114.0	+384
4.0	60	60	60	+230	16.00	36.0	120.0	120.0	+190	120.0	120.0	+420
4.2	63	63	63	+244	16.80	37.8	126.0	126.0	+202	126.0	126.0	+456
4.4	66	66	66	+258	17.60	39.6	132.0	132.0	+212	132.0	132.0	+492
4.6	69	69	69	+272	18.40	41.4	138.0	138.0	+226	138.0	138.0	+528
4.8	72	72	72	+286	19.20	43.2	144.0	144.0	+238	144.0	144.0	+564
5.0	75	75	75	+300	20.00	45.0	150.0	150.0	+250	150.0	150.0	+600

Bracketed values indicate normal values.

Figure 5-1. Systems Test Indicator Conversion Chart (Sheet 3 of 4)

SYS TEST Ind Display	DM 02 Tk 1/2 Qty (%)	DM N2 Tk 1/2 Qty (%)	DM 02 PP A (mm Hg)	DM 02 PP B (mm Hg)	DM Cabin Press. (mm Hg)	UV Exp Pointing (Fly to ind-degrees)
0.0	0	0	0	0	0.0	-1.50
0.2	4	4	20	20	35.2	-1.38
0.4	8	8	40	40	70.4	-1.26
0.6	12	12	60	60	105.6	-1.14
0.8	16	16	80	80	140.8	-1.02
1.0	20	20	100	100	176.0	-0.90
1.2	24	24	120	120	211.2	-0.78
1.4	28	28	140	140	246.4	-0.66
1.6	32	32	160	160	281.6 250.0	-0.54
1.8	36	36	180	180	316.8	-0.42
2.0	40	40	200	200	352.0	-0.30
2.2	44	44	220	220	387.2	-0.18
2.4	48	48	240	240	422.4	-0.06
2.6	52	52	260	260	457.6	+0.06
2.8	56	56	280	280	492.8	+0.18
3.0	60	60	300	300	528.0 550.0	+0.30
3.2	64	64	320	320	563.2	+0.42
3.4	68	68	340	340	598.4	+0.54
3.6	72	72	360	360	633.6	+0.66
3.8	76	76	380	380	668.8	+0.78
4.0	80	80	400	400	704.0	+0.90
4.2	84	84	420	420	739.2	+1.02
4.4	88	88	440	440	774.4	+1.14
4.6	92	92	460	460	809.6	+1.26
4.8	96	96	480	480	844.8	+1.38
5.0	100	100	500	500	880.0	+1.50

Figure 5-1. System Test Indicator Conversion Chart (Sheet 4 of 4)

NORMAL/BACKUP

5.1.2 Limited Use Circuit Breakers

The following list defines circuit breakers which may be open during major portions of flight time. Primary considerations are to maintain maximum crew safety, reduce consumable usage, increase equipment reliability, and furnish redundant capabilities.

Circuit Breakers	Panel Location	When Opened	When Closed	Remarks
O2 VAC ION PUMPS (2)	5	Prelaunch	When required	Closure will be by STDN notification when required.
FLT/PL BUS BAT A, B & C (3)	5	Prelaunch	Prior to splashdown	Opened to isolate bat A & B and bat C from flight and postlanding bus.
EXP PWR A EXP BUS	5	Prelaunch	Prior to SAM experiment (MA0C7)	No further use after experiment.
EXP PWR B & C EXP BUS (2)	5	Prelaunch	When required	No requirements are defined for use of these circuit breakers at the present time.
IVA PWR (2)	5	Prelaunch	When required	No requirements at the present time.
H2O/URINE DUMP HTR MNB	5	Prelaunch	When required	Closed when MNA circuit fails.
CM RCS HTRS (both)	8	Prelaunch	Prior to undocking, deorbit and entry if heating required	Opened to ensure against inadvertent activation. Heating probably will be required.

LIMITED USE CIRCUIT BREAKERS

Circuit Breakers	Panel Location	When Opened	When Closed	Remarks
FLOAT BAG (all)	8	Prelaunch	After splashdown	Opened to ensure against inadvertent activation of float bag compressors and sea dye marker prior to splashdown.
ELS/CM SM SEP (2)	8	Postorbital insertion check	Prior to deorbit and entry	Opened to isolate ELS and CM SM SEP functions until needed.
PL VENT FLT/PL	8	Postorbital insertion check	After splashdown	Opened to ensure against inadvertent activation of postlanding vents.
SECS ARM (2)	8	Postorbital insertion check	During prelaunch, launch, docking, deorbit, and entry procedures	Opened to ensure against inadvertent activation of SECS functions.
EDS (all)	8	Post CSM/SLA separation panel configuration	Prelaunch	No further use after CSM/SLA separation.
RCS LOGIC (2)	8	Post S-IVB separation check	During prelaunch, launch, deorbit, and entry procedures	Opened to ensure against advertent CM/SM RCS transfer and/or CM RCS activation.
DOCK PROBE (2)	8	Before docking probe removal, installation and final separation	Prelaunch and prior to docking probe operation	To ensure electrical power is not at docking ring electrical separation connector when docking ring is jettisoned.
F/C RAD (3)	226	Prelaunch	When required	Precludes inadvertent decrease in radiator area.

NORMAL/BACKUP

Circuit Breakers	Panel Location	When Opened	When Closed	Remarks
PYRO BUS A&B BAT BUS A&B	229	Prelaunch	Only when required, if pyro bats indicate <31.5 vdc during bat check	Connects battery buses to pyro buses in event of pyro battery(s) failure.
MN REL PYRO (2)	229	Prelaunch	Only after splashdown	Opened to prevent premature main parachute release.
UVA EXP MNB	230	Prelaunch	Prior to UVA experiment (MA059)	No further use after experiment.
UVA COVER MNB	230	Prelaunch	Prior to UVA experiment (MA059)	No further use after experiment.
MN BUS INTERCONNECT (2)	250	Prelaunch	When required	Closed to interconnect CSM MN BUS A and B in a contingency.
ETE AC2 (3)	274	Prelaunch	Prior to ETE experiment activation (MA011)	No further use after experiment.
DS CONTROL BAT (2)	274	Prelaunch	Prior to docking and undocking operations	Opened after docking and final undocking operations.
DS MOTORS AC 1 & 2 (6)	274	Prelaunch	Prior to docking and undocking operations	Opened after docking and final undocking operations.
BAT BUS A&B MNA & B (2)	275	Prelaunch	When required	Closed to supply power to battery buses from main buses.
BAT BUS A&B BAT C (2)	275	Prelaunch	When required to connect bat C to bat bus A or B	Connected when bat C is used to back up failed bat A or B.

LIMITED USE CIRCUIT BREAKERS

Circuit Breakers	Panel Location	When Opened	When Closed	Remarks
MNA & B BAT C (2)	275	Prelaunch	Prior to deorbit and as required for bat A or B backup to main buses.	Opened to isolate bat C from main buses.
BAT BUS A&B PYRO BAT A&B (2)	275	Prelaunch	When required to connect pyro battery A or B to bat bus A or B	Closed to provide battery buses with backup source of power.
UPR SYS COMPR (both)	278	Prelaunch	After splashdown	Opened to ensure against inadvertent activation of float bag compressors.
DOCK RING SEP (2)	278	Prelaunch	Prior to dock ring jettison	No further use after dock ring jettison.

5.1.2 LIMITED USE CIRCUIT BREAKERS

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.2 PROPULSION SYSTEMS Specific functions of the SPS and RCS must be monitored to assure operational readiness and capability. SPS and SM RCS monitoring checks are performed during post-orbital insertion check and at 4-hour intervals and after each SPS burn. In addition, the SM RCS monitoring check is performed prior to each SPS burn. The CM RCS monitoring check is performed during post-orbital insertion check and at 12-hour intervals and prior to entry.		
		5.2.1 SPS Monitoring Check		
DP		SPS TEMP IND sw - He PNL, OXID LN SPS TEMP ind - 45°F to 80°F	3	Use A/B position if double heater operation required for temperature control.
		SPS PRESS IND sw - He, N2A, & N2B SPS He/N2 PRESS ind SPS He PRESS - 3750 psia max SPS N2 A PRESS - 2900 psia max SPS N2 B PRESS - 2900 psia max SPS PRESS IND sw - He SPS FUEL PRESS ind - 170-195 psia SPS OXID PRESS ind - 170-195 psia		3600±50 psia at launch, decreases with each burn. 2900 psia at 130°F, decreases with each burn. 2900 psia at 130°F, decreases with each burn. Fuel and oxidizer tanks pressurized with helium prior to launch.
		CAUTION If ΔP between fuel and oxid >20 psi prior to critical SPS burn, repressurize prplnt tanks manually by placing SPS He VLV (both) - ON, ΔP between tanks >20 psi during burn may result in degraded performance, rough combustion, and/or engine failure.		

SPS MONITORING CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SPS INJ VLV ind (4) - CLOSE	3	Each CLOSE indicates two propellant ball valves closed.
		SPS OXID QTY ind - N/A		PUGS deactivated.
		SPS FUEL QTY ind - N/A		PUGS deactivated.
		SPS OXID UNBAL ind - N/A		PUGS deactivated.
		OXID FLOW VLV PRIM - PRIM		PUGS deactivated.
		SPS He VLV (both) - AUTO		
		SPS He VLV tb (both) - bp		Barber pole indicates helium isolation valve closed.
		SYS TEST (2) - 5C		
		SYS TEST ind - 1.3-5.0		Equivalent to +40° - 150°F SPS engine valve body temperature.
		SYS TEST (2) - 6C, 7C, 8C		
		SYS TEST ind - 1.3-3.7		Equivalent to 40 - 110°F SPS oxidizer feed line, SPS fuel check valve, and SPS oxidizer tank outboard temperatures.
		SYS TEST (2) - 3B		
	5.2.2	SM RCS Monitoring Check		In addition to normal monitoring checks, all helium and propellant talkbacks for valves in use should be verified gray after any mechanical shock to CSM.
		NOTE		
		Data in [ ] applies when PSM is active.		
CP		SM RCS QUAD He tb (4) - gray [bp]		Gray indicates both helium main isolation valves open in each quad.
		SM RCS QUAD PRIM PRPLNT tb (4) - gray [bp]		Gray indicates fuel and oxidizer isolation valves open
		SM RCS QUAD SEC PRPLNT tb (4) - gray [bp]	2	Gray indicates fuel and oxidizer isolation valves open
		SM RCS PSM PRPLNT tb (4) - bp [gray]		Barber pole indicates at least one PSM manifold to quad propellant (fuel or oxidizer) isolation valve closed.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PSM He tb - bp [gray]	2	Barber pole indicates at least one of two redundant helium isolation valves closed.
		PSM MANF ISOL tb - gray		Gray indicates both fuel and both oxidizer isolation valves open.
		RCS IND sel - SM A, B, C, D		Check each quad in turn.
		SM RCS PKG TEMP ind - 115°-175°F (C/W 75°-205°F)		Temperature maintained by two redundant and separately selected package heater circuits, each thermostatically controlled between 115°F and 134°F. Above nominal temperature may occur during and after long jet firings. Prolonged cold soak may produce lower than nominal temperatures.
		SM RCS He TK PRESS ind - record (quad)		Nominally 4150 psia before quad used.
		SM RCS IND sw - PRPLNT QTY		
		SM RCS SEC FUEL TK PRESS ind - 178-192 psia (quad)		192-207 psia until quad used, after orbit insertion. Fuel line readout of primary fuel tank only, until secondary tank pressurized - then primary and secondary common manifold if quad isolation valves open.
		SM RCS PRPLNT QTY ind - record % (quad)		
		When SM RCS SEC FUEL TK PRESS ind - 150 psia (quad)		Indicates quad primary fuel quantity low. SM RCS status lights on at 145 psia.
		SM RCS SEC FUEL PRESS A(B, C, D) - OPEN		OPEN position is momentary. No talkbacks. Opens helium isolation valve at quad secondary fuel tank.
		RCS IND sel - PSM		
		SM RCS PKG TEMP ind - zero		Operational only when RCS IND selector at SM A, B, C, or D.
		SM RCS He TK PRESS ind - record (PSM)		Temperature variations cause excursions from nominal.

SM RCS MONITORING CHECK

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	SM RCS FUEL TK PRESS ind - 130-150 psia (before PSM activation)	2	Nominal pressure range for a fully loaded PSM. Partial loads will result in higher pressures.
	SM RCS FUEL TK PRESS ind - 178-192 psia (after PSM activation)		Regulated helium pressure common manifold readout.
	SM RCS QTY ind - record % (PSM)		
	RCS IND sw - MANF PRESS		
	SM RCS FUEL MANF PRESS ind - 130-150 psia (before PSM activation) 178-192 psia (after PSM activation)		Propellant (fuel and oxidizer) distribution manifold pressures same as PSM 1 propellant tank servicing pressures, until used. Pressure ranges given far before PSM activation will result in higher pressures.
	SM RCS OXID MANF PRESS ind - 150-170 psia (before PSM activation) 178-192 psia (after PSM activation)		
	SYS TEST (2) - 10B	101	Equivalent to 30° - 105°F SM RCS PSM fuel tank temperature. Temperature maintained by two redundant and separately selected heater circuits, each thermostatically controlled between primary 50°±3°F and secondary 55°±3°F.
	SYS TEST ind - 1.0-3.5 vdc		
5.2.3	CM RCS Monitoring Check		
	CM RCS PRPLNT tb (both) - gray	2	Gray indicates fuel and oxidizer isolation valves open.
	RCS IND sel - CM 1, 2		Check both CM RCS system 1 and 2 in turn.
	CM RCS He TK TEMP ind - 45°-80°F		
	Prior to CM RCS activation CM RCS He TK PRESS ind - 3900-4300 psia		Temperature variations cause pressure excursions from nominal.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	CM RCS He MANF PRESS ind - 80-105 psia	2	GSE servicing pressure monitored until system activated. Pressure varies with temperature and ullage. If manifold pressure drops suddenly, indicating a ruptured burst diaphragm, close CM RCS propellant isolation valves and then perform procedure for preheating jets (4.15.1.4) for 20 minutes. Procedure vents any propellant trapped between propellant isolation valves and jets by energizing jet valve direct coils.
	After CM RCS activation CM RCS He TK PRESS ind - 3600-3800 psia (after ≈15 min) CM RCS He MANF PRESS ind - 287-302 psia		
	SM RCS QTY ind - zero		Operational only when RCS IND selector at SM A, B, C, D or at PSM 1.
	SYS TEST (2) - 4B, 5B, 6B, 7B, 8B, 9B SYS TEST ind - ambient (vdc)	101	CM RCS engine injector valve temperatures of jets 12 (-R), 14 (-P), 16 (-Y), 21 (+R), 23 (+P), and 25 (+Y) respectively.

CM RCS MONITORING CHECK

5.3 ELECTRICAL POWER SYSTEM

EPS Management

The normal EPS configuration will be with two fuel cells on main bus A and one on main bus B, e.g., FC 1 and 2 on MNA and FC 3 on MNB. If one fuel cell is to be removed from buses, one of two configurations may be assumed. The prime configuration is one fuel cell per bus; for example, fuel cell 1 to main bus A and fuel cell 3 to main bus B. This configuration requires a dual inverter configuration and subsequent load balancing after fuel cell configuration has been established. The second configuration is to have two fuel cells paralleled to buses. This configuration should not be assumed unless equipment malfunction does not permit load balancing or one of the remaining fuel cells performance is degraded.

Standby operation (in-line heaters, reactants and pumps remain on) may be used when powering down spacecraft, as a corrective action for fuel cell malfunctions, or in the event it is desired to hold a fuel cell in reserve for future use. Batteries and remaining fuel cells should be normal when a fuel cell is placed on standby operation (open circuit). Inline heaters and pumps should not be turned off unless fuel cell is to be shut down. If, during the mission, it becomes necessary to conserve cryogenics, electrical loads should be reduced which will in turn decrease flow of cryogenics to fuel cells. In an emergency situation, consideration may be given to deactivate a fuel cell (inline heaters, pumps, and loads off) to conserve cryogenics. During deactive period, continuous monitoring of the fuel cell system will not necessarily assure a reactivation capability and there exists a possibility of complete loss of the fuel cell.

The prime inverter configuration is to have inverter 1 powering ac bus 1 and inverter 2 powering ac bus 2, with inverter 3 as backup. This configuration permits optimum bus isolation; however, reliability of the inverter permits single inverter operation to both ac buses if cryogenics are to be conserved. When a single inverter is used to power both ac buses, there will be a transient when it is tied to the second ac bus. This could cause spurious RCS jet firings and momentary loss of telemetry.

Entry batteries A and B will normally supply main bus A and main bus B respectively with battery C as backup. The batteries (2) should be on during countdown, lift-off, and all delta V maneuvers. Battery C will supply the buses prior to deorbit burn and as required throughout the mission.

NORMAL/BACKUP

Battery C will be connected to buses as required to provide two-battery configuration for delta V maneuvers. All three batteries are to be used during final deorbit burn.

The battery charging cycle should be terminated when either the battery bus voltage indicated on PCM exceeds 39.5 vdc, charger current has decreased to 0.93 amps, or when 100 percent of the expended energy has been replaced. This presumes charger current PCM data availability, and integration of charge current on the ground with STDN advice to crew when 100 percent of charge is returned. If PCM link is lost, voice readouts of the onboard charger DC AMPS indicator will be required at intervals of 20 to 30 minutes for integration on the ground. Charging may be resumed if interrupted before achieving terminal conditions previousl listed. Normal practice is to continue any charge to completion.

Batteries will be checked prior to each GO/NO-GO flight decision, prior to deorbit burn, and in routine periodic checks as required.

The onboard readout will be prime throughout EPS checks.

Application of control voltage less than 22 vdc to any motor switch should be terminated after 10 seconds with repeated applications no more often than once each five minutes. (Under normal bus conditions, motor switches are limited to six transfers in any six-minute period.)

Fuel cell periodic verification consists of updating onboard data and comparing respective fuel cell performance for a particular phase, with established history of the powerplant.

Normal fuel cell purge requirements will be established in flight on the basis of prelaunch purity tests and elapsed amp-hours since previous purge. Purging is accomplished by sequentially purging O2 (for 120 seconds) then H2 (for 80 seconds).

The time required for the H2 vent line heater activation prior to H2 purge has been set at 20 minutes. This time is flexible in that a purge may be attempted with less heater time (for example, a contingency corrective action) with no immediate adverse effect on the powerplant.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.3.1 Cryogenic Pressure-Quantity Check		
CP		CRYO H2 PRESS ind (both) - 225-260 psia	2	Indicates H2 tank 1 and 2 pressure.
		O2 PRESS IND sw - SURGE TK		
		CRYO O2 PRESS 1 ind - 865-935 psia		Indicates surge tank O2 pressure
		O2 PRESS IND sw - TK 1		
		CRYO O2 PRESS ind (both) - 865-935 psia		Indicates O2 tank 1 and 2 pressure.
		CRYO H2 QTY ind (both) - record		Nominal per mission profile curve, 100% maximum indicates full tank (28 lbs each tank).
		CRYO O2 QTY ind (both) - record		Nominal per mission profile curve, 100% maximum indicates full tank (320 lbs each tank).
		5.3.2 FC Power Plant Check		
DP		FC HTRS (all) - on (up)	3	Enables electronic switches which automatically apply or remove power to fuel cell heaters.
		FC RAD tb (all) - gray		Gray indicates fuel cell radiator panel not bypassing flow.
		FC REACS tb (all) - gray		Gray indicates both reactant valves open for each fuel cell.
FC		FC IND sel - 1, 2, 3		
		FC H2 FLOW ind - 0.03-0.15 lb/hr		Flow limits are proportional to individual fuel cell currents and can be approximated by fuel cell O2 flow ≈(amps x 2.0)/100, and fuel cell H2 flow ≈(amps x 2.5)/1000.
		FC O2 FLOW ind - 0.25-1.2 lb/hr		
		FC SKIN TEMP ind - 390°-440°F		
		FC COND EXH TEMP ind - 150°-175°F		
		FC pH HI tb - gray		Gray indicates pH factor normal.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	5.3.3 D-C Voltage-Amperage Check		
DP	MN BUS TIE (2) - OFF (verify)	5	
	SM PWR SOURCE 1 & 2 MNA tb (2) - gray	3	Gray indicates fuel cells 1 and 2 connected to main bus A. Barber pole indicates fuel cell 3 disconnected from main bus A.
	SM PWR SOURCE 3 MNA tb - bp		
	SM PWR SOURCE 1 & 2 MNB tb (2) - bp		Barber pole indicates fuel cells 1 and 2 disconnected from main bus B. Gray indicates fuel cell 3 connected to main bus B.
	SM PWR SOURCE 3 MNB tb - gray		
	DC IND sel - SM SOURCE 1, 2, 3		
	DC AMPS ind - record amps		Record dc amps for each fuel cell.
	DC IND sel - MNA, B		
	DC VOLTS ind - 26.5-31 vdc (record)		Record dc volts for main buses A and B.
	DC IND sel - BAT BUS A, B, & BAT C		
	DC VOLTS ind - 31.5-38.0 vdc		Voltage indication may be different than shown when charging battery.
	DC AMPS ind - <3.0 amps		
CP	SYS TEST (2) - 3B	101	Verifies battery relay bus voltage 30.5 to 37.0 vdc and verifies system test indicator. Perform if convenient.
	SYS TEST ind - 3.4-4.1 vdc		
DP	DC IND sel - PYRO BAT A, B	3	Check pyro batteries A and B once every 24 hours.
	DC VOLTS ind - 31.5-38.0 vdc		
	DC IND sel - MNA		
	5.3.4 A-C Voltage Check		
	AC IND sel - BUS 1, 2, ØA, B, C		
	AC VOLTS ind - 113-117 vac		

A-C VOLTAGE CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.3.5 Battery A (B, C) Charging		If battery charge started immediately after discharge, charger current may be high and/or voltage may be low.
DP		MN BUS TIE (2) - OFF	5	Placing MN BUS TIE switches OFF disconnects battery from main buses.
		cb BAT RLY BUS BAR A(B) - open (except BAT C charge)		
		cb BAT BUS A & B PYRO BAT A & B(2) - open (verify)	275	
		cb BAT BUS A & B BAT C(2) - open (verify)		
		cb PYRO BUS A & B BAT BUS A & B(2) - open (verify)	229	
		DC IND sel - BAT CHGR	3	
		BAT CHG - A, B or C		
		DC VOLTS ind - 37.5-39.5 vdc		
		BAT CHG - OFF (at STDN request or when DC VOLTS ind reads 39.5 vdc or DC AMPS ind reads 0.93 amp)		
		cb BAT RLY BUS BAT A(B) - close (except BAT C charge)	5	
		If pyro battery A or B charge desired		If D-C Voltage Check indicates pyro battery A(B) requires charging, possibility of malfunction exists in pyro battery circuits, and should be investigated.
		MN BUS TIE (2) - OFF		
		cb BAT RLY BUS BAT A(B) - open		
		cb BAT BUS A(B) BAT A(B) - open	275	
		cb BAT BUS A(B) BAT C - open (verify)		
		cb BAT BUS A(B) PYRO BAT A(B) - close		
		DC IND sel - BAT CHGR	3	
		BAT CHG - A(B)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		DC VOLTS ind - 37.5-39.5 vdc	3	
		BAT CHG - OFF (at STDN request or when DC VOLTS ind reads 39.5 vdc or DC AMPS ind reads 0.93 amp)		
		cb BAT BUS A(B) PYRO BAT A(B) - open	275	
		cb BAT BUS A(B) BAT A(B) - close		
		cb BAT RLY BUS BAT A(B) - close	5	
		DC IND sel - MNA	3	
CP		SYS TEST (2) - 2B	101	
		SYS TEST ind - <2.3 vdc (after sea level ambient press ≈14 psia has been vented)		
		If >2.3 vdc, notify STDN		
		If ≈0.0 vdc, BAT VENT vlv - CLOSED, notify STDN		
		SYS TEST (2) - 3B		
	5.3.6	FC Power Plant Purging		Refer to purge information at beginning of 5.3. Purging is performed as determined by real time decision.
DP	1	O2 purging		
		FC IND sel - 1, 2, or 3	3	
		FC 1, 2, or 3 PURG - O2 (2 min)		
		FC O2 FLOW ind - flow incr ≈0.6 lb/hr		O2 flow rate will increase ≈0.6 lb/hr.
		FC 1, 2, or 3 PURG - OFF		
	2	H2 purging		
		H2 PURG LINE HTR - on (up), 20 min prior to purge		
		FC IND sel - 1, 2, or 3		
		FC 1, 2, or 3 PURG - H2 (1 min, 20 sec)		

FC POWER PLANT PURGING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	2	FC H2 FLOW ind - flow incr & peg meter at upper limit of 0.2 lb/hr FC 1, 2, or 3 PURG - OFF After 10 min H2 PURG LINE HTR - OFF	3	H2 flow rate will increase ≈0.7 lb/hr.
	5.3.7	Fuel Cell Load Disconnect (Example using FC 2)		This procedure is presented with the following assumptions: Fuel cells 1 and 2 powering dc main bus A. Fuel cell 3 powering dc main bus B.
	a.	Prior to Disconnect Ensure that at least one FC is powering each main bus FC disconnect (1) Prime configuration		Requires load balancing.
		SM PWR SOURCE 2 MNA - OFF SM PWR SOURCE 2 MNB - OFF (verify)		Fuel cell 2 is now disconnected from both dc main buses.
		SM PWR SOURCE 2 MNA & B tb (2) - bp		Barber poles indicate fuel cell 2 is disconnected from main bus A and main bus B.
		SM PWR SOURCE 1 MNA tb - gray		Gray indicates fuel cell is connected to main bus A.
		SM PWR SOURCE 1 MNB tb - bp		Barber pole indicates fuel cell 1 is disconnected from main bus B.
		SM PWR SOURCE 3 MNA tb - bp		Barber pole indicates fuel cell 3 is disconnected from main bus A.
		SM PWR SOURCE 3 MNB tb - gray		Gray indicates fuel cell 3 is connected to main bus B.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	(2) Secondary configuration		This configuration is assumed if load balancing cannot be obtained.
CP	SM PWR SOURCE 1 MNB - on (up) SM PWR SOURCE 3 MNA - on (up)	3	On position is momentary. On position is momentary.
ALL	MASTER ALARM pb/lt (3) - on	1,3,122	MASTER ALARM and SM PWR DISC lights are energized when SM PWR SOURCE main bus switches pass through center position when placing fuel cells on main buses.
CP	SM PWR DISC lt - on (momentary)	2	
ALL	MASTER ALARM pb/lt - push, out	1,3,122	
CP	C/W lts (all) - out	2	
DP	SM PWR SOURCE 2 MNA - OFF SM PWR SOURCE 2 MNB - OFF (verify)	3	Fuel cell 2 disconnected from both dc main buses. Fuel cells 1 and 3 paralleled to both dc main buses.
	SM PWR SOURCE 1 MNA & B tb (2) - gray		Gray indicates fuel cell 1 connected to main buses A and B.
	SM PWR SOURCE 3 MNA & B tb (2) - gray		Gray indicates fuel cell 3 connected to main buses A and B.
	SM PWR SOURCE 2 MNA & B tb (2) - bp		Barber poles indicate fuel cell 2 disconnected from main buses A and B.
	b. Return FC to Normal Configuration FC to bus connection		
	SM PWR SOURCE 2 MNA - on (up)		On position is momentary.

FUEL CELL LOAD DISCONNECT

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	MASTER ALARM pb/lt (3) - on	1,3,122	MASTER ALARM and SM PWR DISC lights are energized when SM PWR SOURCE main bus switches pass through center position when placing fuel cells on main buses.
CP	SM PWR DISC lt - on (momentary)	2	
ALL	MASTER ALARM pb/lt - push, out	1,3,122	
CP	C/W lts (all) - out	2	
DP	SM PWR SOURCE 1 MNB - OFF SM PWR SOURCE 3 MNA - OFF	3	Fuel cells returned to normal configuration (fuel cell 1 and 2 powering dc main bus A and fuel cell 3 powering dc main bus B).
	SM PWR SOURCE 2 MNA tb - gray SM PWR SOURCE 2 MNB tb - bp		Gray indicates fuel cell 2 connected to main bus A, barber pole indicates fuel cell 2 disconnected from main bus B.
	SM PWR SOURCE 1 MNA tb - gray		Gray indicates fuel cell 1 connected to main bus A.
	SM PWR SOURCE 1 MNB tb - bp		Barber pole indicates fuel cell 1 disconnected from main bus B.
	SM PWR SOURCE 3 MNA tb - bp		Barber pole indicates fuel cell 3 disconnected from main bus A.
	SM PWR SOURCE 3 MNB tb - gray		Gray indicates fuel cell 3 connected to main bus B.
5.3.8	Inverter Changeover		Normal operation throughout mission will be with 2 inverters operating. During drifting flight, a single inverter is adequate to power both ac buses; however, two-inverter operation is assumed, providing maximum bus isolation.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		WARNING		
		Ensure at least one inv on each ac bus at all times (if available).		If 3 inverters are switched onto one ac bus, loss of ac power to that bus will result.
	a.	Dual Inv (No. 1 & 2) Oper		This procedure is presented with the assumption that inverter 1 is powering ac bus 1 and 2.
DP		AC2 RSET - OFF	3	
		INV 2 - MNB		During dual inverter operation, inverter connected to dc main bus A should always power ac bus 1 and inverter connected to dc main bus B should always power ac bus 2, to preclude loss of all ac and dc power to SCS in event of single dc main bus failure.
		INV 1 AC2 - OFF		S-band phaselock will be lost upon switching inverters.
		INV 2 AC2 - on (up)		Inverter 1 now powering ac bus 1 and inverter 2 powering ac bus 2. Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when inverter is connected to bus.
		AC2 RSET - RSET		RSET position is momentary.
ALL		MASTER ALARM pb/lt (3) - on	1,3,122	Placing AC1 or 2 RSET switch to RSET and releasing ensures a MASTER ALARM pb/lt - on. Placing AC1 or 2 RSET to center will cause random activation of MASTER ALARM pb/lt.
		MASTER ALARM pb/lt - push		
		MASTER ALARM pb/lt (3) - out		
CP		C/W lts (all) - out	2	
DP		Perform AC Voltage Check, 5.3.4		

INVERTER CHANGEOVER

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		b. Single Inv Oper		This procedure is presented with the assumption that inverter 1 is powering ac bus 1 and inverter 2 is powering ac bus 2.
DP		AC2 RSET - OFF INV 2 - OFF	3	
		INV 2 AC2 - OFF		S-band phaselock will be lost upon switching inverters.
		INV 1 AC2 - on (up)		Inverter 1 now powering ac bus 1 and ac bus 2. Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when inverter is connected to bus.
		AC2 RSET - RSET		RSET position is momentary.
ALL		MASTER ALARM pb/lt (3) - on MASTER ALARM pb/lt - push MASTER ALARM pb/lt (3) - out	1,3,122	Placing AC1 or 2 RSET switch to RSET and releasing ensures a MASTER ALARM pb/lt - on. Placing AC1 or 2 RSET to center will cause random activation of MASTER ALARM pb/lt.
CP		C/W lts (all) - out	2	
DP		Perform AC Voltage Check, 5.3.4		
		c. Stby Inv (No. 3) Check or Oper		This procedure is presented with the assumption that inverter 1 is powering ac bus 1 and inverter 2 is powering ac bus 2.
		AC2 RSET - OFF INV 2 - OFF	3	
		INV 3 - MNB		When switching inverter 3 from one main dc bus to the other, pause momentarily in OFF position.
		INV 2 AC2 - OFF		S-band phaselock will be lost upon switching inverters.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		INV 3 AC2 - on (up)	3	Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when inverter is connected to bus.
		AC2 RSET - RSET		RSET position is momentary.
ALL		MASTER ALARM pb/lt (3) - on MASTER ALARM pb/lt - push MASTER ALARM pb/lt (3) - out	1,3,122	Placing AC1 or 2 RSET switch to RSET and releasing ensures a MASTER ALARM pb/lt - on. Placing AC1 or 2 RSET to center will cause random activation of MASTER ALARM pb/lt.
CP		C/W lts (all) - out	2	
DP		Perform AC Voltage Check, 5.3.4	3	Standby inverter (No. 3) check should be performed every 24 hours.
		If stby inv check Go to dual inv (No. 1 & 2) oper, 5.3.8a, & set INV 3 - OFF		
	5.3.9	H2 Manual Fan Operation		Manual H2 fan operation should be used during flight to prevent possible cryo pressure control motor switch arcing, which may cause a-c inverter a-c bus disconnect.
		CAUTION In the following step, if CRYO PRESS lt illuminates, do not set H2 FANS - off (ctr) or proceed to next step until lt extinguishes.		
		H2 FANS both - ON, then off (ctr) sequentially for 1 min prior to and subsequent to crew rest periods.		

H2 MANUAL FAN OPERATION

5.4 ENVIRONMENTAL CONTROL SYSTEM

ECS systems management procedures are divided into two categories. The first category consists of five procedures, described in steps 1 through 5, that are conducted at specific time intervals.

1. An ECS monitoring check is recommended every hour from time the SC attains orbit until CSM separation. This check provides crew with latest status of the ECS.

2. A redundant component check is accomplished at 24-hour intervals to determine operational status of certain ECS redundant components and secondary water-glycol loop. The test will reveal any inoperative or malfunctioning components that might have been selected for use later in the mission. Several redundant components are not checked, however, because of excessive use of oxygen, a means of selection not incorporated, or lack of direct indication.

3. Replacement of one CO2-odor absorber filter is required on an alternate basis, at 12-hour intervals, for the ECS to remain within prescribed metabolic limit. Filters are also changed if CO2 partial pressure exceeds 7.6 mm Hg.

4. It is recommended that at 24-hour intervals the debris screen on suit circuit return valve be checked and cleaned as necessary.

5. It is recommended that chlorine and a buffer chemical be individually injected into potable water supply every 24 hours to maintain potability. There is a 10-ampoule supply of each chemical on the CM. Should a condition exist where either glycol evaporator is in use and waste water tank is empty, chlorine and buffer injections should be postponed.

The second category consists of procedures, described in steps 1 through 13, that are accomplished at random intervals or only as required.

1. PGA/shirtsleeve mode changes require certain precautions to be taken regarding suit power switch settings, communication functions and ECS adjustments. This applies whether the mode change is from PGA-to-shirtsleeve, shirtsleeve-to-PGA, or full PGA to partially suited mode.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	10. Procedural data is provided for donning and doffing the emergency oxygen masks.		
	11. Data for servicing the gas separator cartridges is provided. Separator cartridges are used as a backup for normal system H2/H20 separator.		
	12. The steps required to activate or deactivate the primary glycol evaporator are provided. Such action may be necessary to prevent navigation perturbations due to steam venting or for any other reason.		
	13. Procedures are provided for checking CM, cabin for leaks prior to rest periods and following completion of eating and overboard dumps.		
	5.4.1 ECS Monitoring Check		
CP	SUIT CAB ΔP ind - -1.0 to -3.5 in H20 02 FLOW ind - 0.2-0.45 lb/hr	2	02 flow may be as high as 1.0 lb/hr (pegged) prior to completion of cabin purge.
	02 PRESS IND sw - SURGE TK CRYO 02 PRESS 1 ind - 865-935 psia 02 PRESS IND sw - TK 1 REPRESS 02 PRESS ind - >865 psia	602	
	ECS RAD tb - gray	2	Gray indicates No. 1 flow proportioning valve is controlling flow.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If ECS RAD tb - 2 RAD FLOW CONT AUTO - 1 until tb gray (≈20 sec), then AUTO		Attempt resetting talkback before assuming radiator proportioning malfunction.
	If tb cannot be reset RAD FLOW CONT AUTO - 1		

ECS MONITORING CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		RAD PRIM OUT TEMP ind - within correct range	2	Correct range indicates talkback malfunction only, with both proportioning systems and failure detection circuit operable.
		RAD FLOW CONT AUTO - AUTO RAD PRIM OUT TEMP ind - outside correct range		
		Refer to ECS Malfunction Procedure PRIM ECS RAD OUT TEMP HIGH, in the Flight Data File		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		ECS IND sel - PRIM RAD PRIM IN TEMP ind - 60°-90°F RAD PRIM OUT TEMP ind - -12° to +65°F PRIM GLY EVAP OUT TEMP ind - 38°-50.5°F (EVAP AUTO); 42°-67°F (EVAP OFF) PRIM GLY EVAP STM PRESS ind When boiling - 0.09-0.14 psia Not boiling - 0.14 psia PRIM GLY DISCH PRESS ind - 39-52 psig SUIT TEMP ind Without evap - 45°-70°F With evap - 45°-55°F CAB TEMP ind - 70°-80°F SUIT PRESS ind - CAB PRESS ind CAB PRESS ind - 4.7-5.3 psia		Cabin pressure will be 5.6 to 6.2 psia after launch and continuously decrease until cabin pressure regulator activates and controls to 4.7 to 5.3 psia.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		CO2 PP ind - <7.6 mm Hg SUIT COMPR ΔP ind - 0.3-0.4 psid PRIM ACCUM QTY ind - 30-65% If quantity <30%	2	
CP,DP		PRIM ACCUM FILL vlv - ON until 40-55% is reached	379,2	
CP		H2O QTY IND sw - POT POT H2O QTY ind - 10-100% H2O QTY IND sw - WASTE WASTE H2O QTY ind - 15-90%	2	
	5.4.2	ECS Redundant Component Check		
	1	Suit compressor		
DP		SUIT COMPR (both) - redundant compr	4	
CP		SUIT COMPR ΔP ind - 0.3-0.4 psid	2	
	2	Suit demand regulators		
AC		DEMAND REG sel - 1 Close demand reg cabin bleed port with finger	380	Obstruct bleed flow only long enough to obtain momentary high flow.
CP		O2 FLOW ind - momentary incr	2	
AC		DEMAND REG sel - 2 Close demand reg cabin bleed port with finger	380	Obstruct bleed flow only long enough to obtain momentary high flow.
CP		O2 FLOW ind - momentary incr	2	
AC		DEMAND REG sel - BOTH	380	
	3	Main O2 regulators		
CP		MN REG B - close EMER CAB PRESS sel - 1 EMER CAB PRESS TEST pb - push	351	Press-to-test pushbutton held only long enough to obtain momentary high flow.

ECS REDUNDANT COMPONENT CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		02 FLOW ind - pegged high	2	
		MN REG B - OPEN	351	
		MN REG A - close		
		EMER CAB PRESS sel - 2		
		EMER CAB PRESS TEST pb - push		Press-to-test pushbutton held only long enough to obtain momentary high flow.
		02 FLOW ind - pegged high	2	
		MN REG A - OPEN	351	
		EMER CAB PRESS sel - BOTH (OFF if all crewmen suited)		
	4	H2O accumulators		
		SUIT H2O ACCUM AUTO - redundant accum	2	
		02 FLOW ind - monitor for momentary (10 sec) incr		Allow up to 10 minutes for accumulator stroking.
	5	Urine dump nozzle heaters		
		WASTE H2O DUMP - redundant heater	101	
		URINE DUMP - redundant heater		
		STDN reports no significant change in urine & water dump nozzle temperatures		Nozzle temperatures are telemetered only. Temperature decrease indicates heater failure; however, if nozzles are facing sun, decrease may not be immediate.
	6	Open coolant control atten panel		Covers panel 382. Opened to perform part of secondary glycol loop check.
		WARNING		
		SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of C02 odor absorber filters may result.	382	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	7	Secondary glycol loop		Coldplates are not provided in secondary glycol loop for DSE and G&N. Usage time for noncoldplated items is as follows: DSE: 2 hours ON, 1 hour OFF. G&N: 1.9 hours ON, 9.2 hours OFF.
CP		GLY TO RAD SEC vlv - BYP	377	
		SEC EVAP H2O CONT - AUTO	382	
		ECS IND sel - SEC	2	
		SEC COOL PUMP - AC1		
		SEC GLY DISCH PRESS ind - 39-52 psig		
		SEC ACCUM QTY ind - 30-60%		
		SEC COOL EVAP - EVAP		
		SEC GLY EVAP STM PRESS ind		
		When boiling - 0.09-0.14 psia		
		Not boiling - >0.14 psia		
		After 5 min		
		SEC GLY EVAP OUT TEMP ind - 38°-50.5°F		
		SEC COOL PUMP - AC2		
		SEC COOL PUMP ind - 39-52 psig		
		SEC COOL EVAP - RSET for 58 sec min, then off (ctr)		RSET closes steam pressure control valve. Steam pressure valve requires 58 seconds from full open to full close.
		ECS IND sel - PRIM		
		SEC COOL PUMP - off (ctr)		
	8	Secondary radiator leak check		
		Monitor SEC ACCUM QTY ind		
		GLY TO RAD SEC vlv - NORM for 30 sec, then BYP	377	
		SEC ACCUM QTY ind - no change	2	

ECS REDUNDANT COMPONENT CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	9	Close coolant control atten panel		Covers panel 382.
	10	Primary glycol pumps		
DP		GLY PUMPS - redundant pump	4	Switch to pump opposite that on at beginning of test. This verifies primary loop pump operation.
CP		PRIM GLY DISCH PRESS ind - 39-52 psig PRIM ACCUM QTY ind - 30-65%	2	
		5.4.3 CO2 Absorber Filter Replacement		
		CAUTION Connect ground wire when removing or replacing filter from canister or stowage.		
		Obtain unused filter		

Filter No.	Stowage Container	Filter No.	Stowage Container
1	Canister A	14	D4
2	Canister B	15	D4
3	CM (TBD)	13	D4
4		17	D4
5		15	D4
6		16	D4
7		17	D4 DM
8		18	D4
9		19	D4
10		20	D4
		21	D4
		22	D4

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Open CO2 canister atten panel CO2 CSTR DIVERT vlv - up (or dn)	350	Handle placed up for canister B filter change, down for canister A filter change.
		CAUTION Apply pressure to latching handle to allow pressure interlock pin to withdraw, otherwise latching handle may not disengage.		
		Canister manual bleed vlv - press Cover latching handle - unlock Replace used filter Cover latching handle - lock CO2 CSTR DIVERT vlv - ctr Close CO2 canister atten panel Stow used filter Stow excess shims		For stowage, reference NASA document (TBD).
	5.4.4	Debris Screen Check		Lint or other debris on screens may reduce flow substantially.
AC	a.	SUIT RETURN vlv screen Open coolant control atten panel	380	Covers panel 382 and SUIT RETURN valve screen.
		WARNING		
CP		SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of CO2 odor absorber filters may result.	382	

DEBRIS SCREEN CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If debris is present		
AC		SUIT RETURN vlv - CLOSE PUSH	380	
CP		Clean screens		
AC		SUIT RETURN vlv - OPEN PULL		
CP		Close coolant control atten panel		
		b. Cabin ht exch inlet screen		
		CAB FAN (both) - OFF (verify)	2	
		Check cabin ht exch inlet screen		
		If debris present - clean screen		
		5.4.5 Potable Water Chlorination		Chlorine concentration must not exceed 6 ppm.
		CAUTION		
		If waste water quantity is approaching empty (read ≤15%) and either glycol evaporator is in operation, chlorination procedure will not be performed, as impairment of evaporator efficiency may result.		
	1	Check POT H2O QTY ind - if >85%, withdraw 8 oz of water		It is necessary to withdraw water to allow space for water flow into tank after chlorine and buffer injection.
ALL	2	Retrieve chlorination unit		For stowage, reference NASA document (TBD).
	3	Remove chlorination port cap		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
ALL		Chlor port leaking Use tools W & 3 Insert tool 3 only 1/4 inch into insert socket Tighten (CW) 1/4 turn with tools W & 3		Prevents torque set driver puncturing grommet.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	4	Attach needle assy to inject port	352	
	5	Insert chlorine ampoule into casing		Chlorine ampoules color-coded red.
	6	Connect knob assy & rotate (CW) until piston contacts ampoule firmly		
ALL	7	Install ampoule assy on needle assy (push and turn CW)		
		CAUTION If potable water quantity is <50%, inject half the contents of each ampoule (chlorine and buffer) by rotating knob three turns (CW).		
	8	Rotate knob ≈3-1/2 turns (CW) until ampoule is empty (piston bottoms out)		Two turns for half empty if H20 quantity <50%.
	9	Disconnect ampoule assy from needle assy (push & turn CCW)		

POTABLE WATER CHLORINATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
ALL	10	Rotate knob (CCW), remove & stow used ampoule	352	Place used ampoule in chlorination unit stowage bag.
	11	Repeat steps 5 through 8 using buffer ampoule		Buffer ampoules color-coded brown.
	12	Wait 10 min, remove ampoule of H20 by slowly rotating injector barrel (CCW) three turns while holding bayonet section in locked position (CW).		
	13	Rotate knob (CCW), remove & stow used ampoule		
	14	Stow chlorination unit		
	15	Replace chlorination port cap		
		CAUTION Wait 30 min before withdrawing water for drinking or food preparation.		
	5.4.6	PGA Mode Changes		
		a. PGA to Shirtsleeve		Two flow paths exist for returning cabin atmosphere to suit circuit for scrubbing.
CP		CAB PRESS ind -> 4.7 psia (verify)	2	
		EMER CAB PRESS sel - BOTH	351	
ALL		Doff and stow gloves & helmet		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If suit return vlv is used		
AC	SUIT RETURN vlv - OPEN PULL	380	
ALL	Retrieve inflight coveralls		
	SUIT PWR - OFF	9,10,6	
	PWR - OFF		
	AUDIO CONT - NORM		
	WARNING		
	If comm umbilical is to be disconnected at bulkhead or control head, VHF AM sw on associated panel must be placed OFF & S BD MODE PCM sw must be in PCM or ctr.		
	Disconnect O2 & comm umbilicals at PGA & insert interconnect in O2 return hose		
	If suit return vlv is not used		
	Retrieve inflight coveralls		
	SUIT PWR - OFF		
	PWR - OFF		
	AUDIO CONT - NORM		
AC	DEMAND REG sel - OFF	380	Screens plus hose causes increased pressure drop in suit circuit causing O2 demand flow.
	WARNING		
	If comm umbilical is to be disconnected at bulkhead or control head, VHF AM sw on associated panel must be placed OFF & S BD MODE PCM sw must be in PCM or ctr.		

PGA MODE CHANGES

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	Disconnect O2 & comm umbilicals at PGA & install suit return hose screen cap		Suit donning and suit loop isolation requires additional time for repositioning suit flow valves (inaccessible from couches) in addition to normal suiting time.
CP	SUIT FLOW vlv - CAB FLOW (for unsuited crewmen)	300,301,302	Adjust suit flow valve between CAB FLOW and FULL FLOW to maintain adequate flow for suited crewman.
ALL	Disconnect UTCA, comm & biomed connectors Doff & stow UTCA & PGA Don inflight coveralls Retrieve & connect CWG adapter to comm & biomed connectors Audio panel sw (all) - as desired	9,10,6	Comm and biomed integrity should be verified.
	b. Shirtsleeve to PGA SUIT PWR - OFF PWR - OFF AUDIO CONT - NORM WARNING If comm umbilical is to be disconnected at bulkhead or control head, VHF AM sw on associated panel must be placed OFF & S BD MODE PCM sw must be in PCM or ctr.		Two flow paths exist for returning cabin atmosphere to suit circuit for scrubbing.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
ALL		Disconnect & stow CWG adapter Doff & stow inflight coveralls Retrieve & don UTCA & PGA, connecting UTCA, comm & biomed connectors		
		If suit return vlv is used Remove O2 umbilical interconnect & connect O2 & comm umbilicals to PGA		Connect blue to blue and red to red.
AC		SUIT RETURN vlv - CLOSE PUSH (if all suited)	380	
		If suit return vlv is not used Remove suit circuit return hose screen cap & connect O2 & comm umbilicals		Connect blue to blue and red to red. Suit donning and suit loop isolation requires additional time for repositioning suit flow valves (inaccessible from couches) in addition to normal suiting time.
		DEMAND REG sel - BOTH	380	
ALL		SUIT FLOW vlv - FULL FLOW (for suited crewman)	300,301,302	
		Audio panel sw (all) - as desired	9,10,6	Comm and biomed integrity should be verified.
		Retrieve & don helmet & gloves		
CP		EMER CAB PRESS sel - OFF (if all suited)	351	
	c.	PGA to Partial PGA		Two flow paths exist for returning cabin atmosphere to suit circuit for scrubbing.
		CAB PRESS ind - >4.7 psia (verify)	2	
		EMER CAB PRESS sel - BOTH		
ALL		Doff & stow gloves & helmet		

PGA MODE CHANGES

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If suit return vlv is used		
AC		SUIT RETURN vlv - OPEN PULL	380	
ALL		Reverse 02 umbilical connections at PGA Supply hose to outlet connector Return hose to inlet connector		02 umbilicals reversed for optimum flow distribution within PGA.
		If suit return vlv is not used		
AC		DEMAND REG sel - OFF		Screens plus hose cause increased pressure drop in suit circuit causing 02 demand flow.
ALL		Disconnect return hose from PGA & install suit return hose screen cap Connect supply hose to outlet connector		

5.4.7 Waste Management Procedures

WARNING

If germicide pouch is accidently ruptured, proceed as follows:

- Germicide on CM surface or hardware; wipe up with tissue.
- Germicide on crewman's skin; blot with tissue and flush with water.
- Germicide in crewman's eyes; irrigate with water from water gun or soaked tissue.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		• Germicide ingested; take magnesium compound and/or high protein food - do not induce vomiting.		
	a.	Urine Dump Modes		
ALL	(1)	PGA urine collection (UCTA) bag		
		Connect urine line filter to urine trnfr hose		For stowage, reference NASA document (TBD).
		Connect urine trnfr hose/ filter to urine/overboard QD		
		Remove cap from PGA thigh QD and stow		Temporary stowage.
		Connect urine trnfr hose T QD to thigh QD		
		OVBD DRAIN vlv - DUMP	251	
		When PGA bag (UCTA) empty, disconnect urine trnfr hose T QD at PGA thigh QD		
		Replace cap on PGA thigh QD		
		Connect adapter to urine trnfr hose (tethered to hose)		
		Connect UTS to urine trnfr hose/filter QD		
		UTS vlv - open		
		Purge until particles cease exhausting vent line (2 to 5 min), then OVBD DRAIN vlv - OFF		View urine expulsion from dump nozzle through left window No. 1.

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	UTS vlv - close Disconnect UTS from urine trnfr hose and stow Disconnect urine trnfr hose from urine/overboard QD and stow	251	For stowage, reference NASA document (TBD).
	(2) UTS (collection)		Used when inconvenient for simultaneous urination and overboard dumping.
	Obtain UTS and verify vlv closed Roll cuff - affixed UTS vlv - open Perform task		Six spare roll-on cuffs stowed in medical accessory kit and one spare receiver assembly provided.
	UTS vlv - close Roll cuff - removed Free urine in cuff absorbed with tissue UTS - stow (temporary) When convenient, dump urine by UTS (dump) procedure		
	(3) UTS (dump) Connect urine line filter to urine trnfr hose (verify) Connect urine trnfr hose/ filter to urine/overboard QD Connect adapter to urine trnfr hose (tethered to hose)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	Obtain UTS and verify vlv closed		For stowage, reference NASA document (TBD).
	Attach UTS to urine trnfr hose/adapter QD		
	Perform UTS (collection) (if req), 5.4.7a (2)		
	OVBD DRAIN vlv - DUMP	251	
	When UTS bag empty, UTS vlv - open		
	Purge 2-5 min, then OVBD DRAIN vlv - OFF		
	UTS vlv - close		
	Disconnect UTS from urine trnfr hose/adapter and stow		
	Disconnect urine trnfr hose from urine/overboard QD and stow		
	(4) Urine Receptacle Assy (URA)		GFE assembly.
	Connect urine line filter to urine trnfr hose		
	Connect urine trnfr hose/filter to urine/overboard QD		
	Connect urine receptacle to urine trnfr hose		
	URA vlv - VENT		
	Remove receptacle cover		
	OVBD DRAIN vlv - DUMP		
	Perform task		Direct urine stream parallel to honeycomb to prevent splashback. Avoid accelerations to URA during use. Remove last drop by touching screen at top of URA.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
ALL		Flush screen & honeycomb with water gun (10 sec max)	251	
		Replace receptacle cover after liquid has cleared from URA		
		URA vlv - VENT (verify) and purge URA for 2-5 min		
		URA vlv - CLOSE (CW)		
		Stow URA for next use with urine trnfr hose conn & OVBD DRAIN vlv - DUMP (verify)		Allows URA to vacuum dry between uses.
		For stowage prior to entry OVBD DRAIN vlv - OFF		
		Remove & stow URA, urine trnfr hose & urine filter		For stowage, reference NASA document (TBD).
	b.	Defecation		
		Remove fecal collection assy from stowage		
		Obtain defecation collection device from assy		
		Remove germicide pouch		
		Insert germicide pouch (protective cover removed) into inner fecal bag		
		Remove protective covering from lip of inner fecal bag & place into bag		Lip of inner fecal bag covered with adhesive.
		Affix inner fecal bag		
		Perform task		
		Seal inner fecal bag		Remove air prior to sealing.
		Rupture germicide pouch		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
ALL		Knead contents for 4 min Insert into outer fecal bag Only subsequent to initial odor detection will waste stowage container be vented prior to each waste deposit WASTE STOW VENT vlv - VENT for 30 sec, then CLOSE	252	
		Stow fecal bag		Fecal matter stowed in waste stowage container.
	c.	Emesis Obtain fecal/emesis (F/E) bag Perform task Insert germicide pouch (protective cover removed) into inner F/E bag Seal inner F/E bag Rupture germicide pouch Insert inner F/E bag into outer F/E bag & seal Only subsequent to initial odor detection will waste stowage container be vented prior to each waste deposit WASTE STOW VENT vlv - VENT for 30 sec, then CLOSE Stow outer F/E bag		
	d.	Side Hatch Urine/Water Dump		For stowage, reference NASA document (TBD).
CP		Remove dump nozzle conn cover and withdraw wires, wire guard, and heater conn from cover	Side hatch	Use tool E. Rotate cover as necessary to permit removal of electrical heater connector. Connector lock pins must be aligned with slots (3) in threaded portion of cover.

WASTE MANAGEMENT PROCEDURES

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Remove plug and stow	Side	Use tool E. For stowage, reference NASA document (TBD).
	Install cable tether retaining ring over aux dump nozzle QD threads		
	Install male QD on dump nozzle (finger tight)		
	Connect cable to htr conn (if req)		The side hatch dump nozzle heater need not be connected (crew option). CM orientation and previous cold soak should be considered when electing not to connect heater. If nozzle freezes, connect and use heater to thaw nozzle.
	UTIL PWR - OFF (verify)	16	
	Connect cable to utility outlet		
	UTIL PWR - ON (up)		
	If urine overboard dump req		
	Connect urine dump hose to dump nozzle QD	Side hatch	Cabin to ambient ΔP will provide for urine flow.
	If waste H2O overboard dump req		
	WASTE TK SERV vlv - CLOSE (verify)	352	
	Remove conn cap on waste tank servicing conn		Use tool L.
	Install female QD on waste tank servicing conn		
	Connect urine dump hose tee-adapter to waste tank servicing conn QD and to dump nozzle QD		
DP	H2O QTY IND sw - WASTE	2	
CP	WASTE TK SERV vlv - OPEN until WASTE H2O QTY ind ≈ 15%, then CLOSE	352	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If req to dump to 0% POT TK IN vlv - OPEN WASTE TK IN vlv - AUTO (verify)	352	A dump to zero could expose the suit heat exchanger to adverse pressure conditions if the POT TK IN vlv and the WASTE TK IN vlv are not configured properly.
		Disconnect urine dump hose tee-adapter from waste tank servicing conn QD		
		Disconnect tee-adapter from urine dump hose and purge (30 sec min)		The tee-adapter is tethered to the urine dump hose. This will provide overboard vent to purge urine dump hose.
		Disconnect urine dump hose from dump nozzle QD and stow	Side hatch	
		Reconnect tee-adapter		
		UTIL PWR - OFF (verify)	16	
		Disconnect heater cable from dump nozzle heater conn and to utility outlet (verify)	Side hatch	
		Remove dump nozzle QD and stow		
		Stow heater cable (verify)		
		Install plug and dump nozzle conn cover		Use tool E.
	e.	Water Collection		
		Conn urine trnfr hose-filter to urine/overboard QD	251	
		Conn cab purge QD to urine trnfr hose		
		OVBD DRAIN vlv - DUMP		
		Collect water		
		After collection is complete		
		Purge until particles cease exhausting vent line (1 to 2 min)		
		OVBD DRAIN vlv - OFF		

WASTE MANAGEMENT PROCEDURES

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		f. Vac Oper Using O2 Umb		
		CAUTION Not to be used for H2O collection. Ingestion of H2O will cause swelling of CO2 cstr element.		
AC		DEMAND REG sel - OFF	380	Screens plus hose cause increased pressure drop in suit circuit causing O2 demand flow.
		SUIT RETURN vlv - close (push)		
ALL		Install one interconnect to two return hoses		
		Use third return hose		
		SUIT FLOW vlv (3) - FULL FLOW	300,301,302	
		At completion of vac		
AC		SUIT RETURN vlv - open (pull)	380	
		DEMAND REG sel - BOTH		
ALL		SUIT FLOW vlv (3) - CAB FLOW	300,301,302	
DP		Remove interconnect & install screen cap on return hose		
	5.4.8	CM Repressurization		
		a. Normal Mode (time ≈30 min)		
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
CP		CAB PRESS DUMP vlv - close (CW) (verify)	Side hatch	
		O2 PRESS IND sw - SURGE TK	2	

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	REPRESS PKG vlv - FILL	326	
	REPRESS 02 - OPEN	601	Guarded.
CP	CRYO 02 PRESS 1 ind - 150 psia min	2	Minimum surge tank pressure.
AC	REPRESS PKG vlv - OFF	326	
CP	CAB PRESS ind - 3.0 psia (in 1 min)	2	
	REPRESS 02 PRESS ind - 0.0 psig	602	
AC	REPRESS 02 - CLOSE	601	Guarded.
CP	CAB REPRESS vlv - open (CW)	351	Maintain 150 psia minimum in surge tank.
	CAB PRESS ind - 4.7-5.3 psia	2	
	02 PRESS IND sw - TK 1		
	CAB REPRESS vlv - OFF (CCW)	351	
	b. Alternate Mode (time 52 min)		
AC	CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
CP	CAB PRESS DUMP vlv - close (CW) (verify)	Side hatch	
	EMER CAB PRESS sel - BOTH	351	
	CAB REPRESS vlv - OPEN (CW)		
	02 PRESS IND sw - SURGE TK	2	
	CRYO 02 PRESS 1 ind - 150 psia min		Minimum surge tank pressure.
	EMER CAB PRESS sel - OFF	351	
	CAB REPRESS vlv - adjust to 150 psia min		
	CAB PRESS ind - 4.7-5.3 psia	2	
	02 PRESS IND sw - TK 1		
	CAB REPRESS vlv - OFF (CCW)	351	

CM REPRESSURIZATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5.4.9	Pressure Suit Circuit & PGA Check at 5.0 Psia		
		Configure Suit Loop Crew members suited & umbilical connected SUIT FLOW vlv not used by crewman - OFF, or PGA 02 umbilical couplings installed		PGA 02 umbilical couplings (3) are plugged.
		a. Gross Suit Circuit Verification		This procedure may be used in lieu of step b, PGA Check Only, to ascertain complete suit loop integrity.
AC CP		DIRECT 02 vlv - close (CW) SUIT PRESS ind - 4.7-5.3 psia 02 FLOW ind - 0.2-0.4 lb/hr	7 2	
		CAUTION • SUIT TEST vlv should remain IN PRESS position until suit circuit pressure is stabilized to preclude seal scarring. • If repositioning of SUIT TEST vlv from PRESS is required prior to suit pressure stabilization, perform the following:		
AC		a. DEMAND REG sel - OFF b. Allow 15 sec (min) stabilization time c. Reposition SUIT TEST vlv - DEPRESS or OFF as applicable d. When suit pressure stabilized, DEMAND REG sel - BOTH	380	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SUIT TEST vlv - PRESS	380	All crewmen exercise PGA joints during pressurization period. DIRECT 02 valve may be slightly opened to reduce suit loop pressurization time, but must be fully closed (CW) at 4.0 psid suit pressure.
CP		02 FLOW ind - 1.0 lb/hr (pegged)	2	
		02 FLOW HI lt - on		After 16-second delay.
ALL		MASTER ALARM pb/lt (3) - on, push	1,3,122	
AC		Cycle SUIT RETURN vlv - OPEN	380	Continue suit circuit pressurizatior until 02 flow starts to decrease.
		PULL & CLOSE PUSH when SUIT PRESS ind - 1.5-2.0 psia >cabin press	2	
CP		SUIT PRESS ind - 8.8-9.8 psia		Crewmen remain inactive while monitoring suit circuit pressure and 02 flow indicator to preclude fluctuations in 02 flow. Monitoring should not be scheduled during H20 accumulator stroking (or 30 seconds thereafter), or accumulators should be temporarily disabled during test (SUIT H20 ACCUM AUTO - ctr, then back to previous position).
ALL		PGA press ind (3) - 4.1-4.5 psid	PGA	
CP		02 FLOW HI lt - out	2	
		02 FLOW ind - stabilize for 15 sec, & remain <0.8 lb/hr for 30 sec after stabilization		
AC		SUIT TEST vlv - DEPRESS	380	
CP		02 FLOW ind - 0.2-0.4 lb/hr	2	
		SUIT PRESS ind - slightly >CAB PRESS ind		In ≈75 seconds.
AC		SUIT TEST vlv - OFF	380	
		DEMAND REG sel - BOTH (verify)		

PRESSURE SUIT CIRCUIT & PGA CHECK AT 5.0 PSIA

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		b. PGA Check Only		This procedure performed only if individual or collective PGA verification required.
AC		DIRECT 02 vlv - close (CW)	7	
CP		SUIT PRESS ind - 4.7-5.3 psia 02 FLOW ind - 0.2-0.4 lb/hr	2	
		CAUTION SUIT TEST vlv should remain in PRESS position until suit circuit pressure is stabilized to preclude seal scarring.		
AC		SUIT TEST vlv - PRESS	380	All crewmen exercise PGA joints during pressurization period. DIRECT 02 valve may be slightly opened to reduce suit loop pressurization time, but must be fully closed (CW) at 4.0 psig suit pressure.
CP		02 FLOW ind - 1.0 lb/hr (pegged) 02 FLOW HI lt - on	2	
ALL		MASTER ALARM pb/lt (3) - on, push	1,3,122	
CP		SUIT PRESS ind - 8.8-9.8 psia	2	After ≈75 seconds.
ALL		PGA press ind (3) - 4.1-4.5 psid	PGA	
		WARNING Suit flow vlv(s) may remain in OFF position for no longer than one min or asphyxiation may result.		

5.4.9 PRESSURE SUIT CIRCUIT & PGA CHECK AT 5.0 PSIA

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION If all suit flow vlvs are closed simultaneously, the suit compressors must be shut off to prevent compressor damage because of deadheading of suit loop.		
CP		SUIT FLOW vlv (suited crewmen) - OFF	300,301,302	
		PGA press ind (suited crewmen) - PGA <0.5 psid/min pressure decay		Crewmen hold breath and remain inactive while monitoring PGA pressure decay to preclude pressure drop or fluctuation on PGA pressure indicators.
		SUIT FLOW vlv (suited crewmen) - FULL FLOW	300,301,302	
		CAUTION If repositioning of SUIT TEST vlv from PRESS is required prior to suit pressure stabilization, perform the following:		
AC		a. DEMAND REG sel - OFF	380	
		b. Allow 15 sec (min) stabilization time		
		c. Reposition SUIT TEST vlv - DEPRESS or OFF as applicable		
		d. When suit pressure stabilized, DEMAND REG sel - BOTH		

PRESSURE SUIT CIRCUIT & PGA CHECK AT 5.0 PSIA

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SUIT TEST vlv - DEPRESS	380	
		02 FLOW HI lt - out	2	
		02 FLOW ind - 0.2-0.4 lb/hr		
		SUIT PRESS ind - slightly >CAB PRESS ind		In ~75 seconds.
AC		SUIT TEST vlv - OFF	380	
	5.4.10	CM 02 Supply Refill		
CP		02 PRESS IND sw - SURGE TK	2	
		CRYO 02 PRESS 1 ind - ≥400 psia		After cabin repressurization, 400 psia is minimum surge tank pressure that will assure an 02 system equilibrium pressure >150 psia at initiation of refill operation.
		CAB REPRESS vlv - OFF (CCW)	351	
AC		REPRESS 02 - CLOSE	601	Guarded.
		REPRESS PKG vlv - FILL	326	
CP		CRYO 02 PRESS 1 ind - 865-935 psia	2	Monitor pressure to ensure no decrease below 150 psia.
		02 PRESS IND sw - TK 1		Upon completing refill operation.
AC		REPRESS PKG vlv - OFF	326	
	5.4.11	CM Pressure Dump		
	a.	Using Cab Press Relf Vlv		
CP		CAB FANS - OFF (verify)	2	
AC		DIRECT 02 vlv - close (CW)	7	
		rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	Valve in DUMP position long enough for cabin pressure to decrease to ~3.25 psia. 02 FLOW HI light may come on prior to cabin pressure regulator lockup.
CP		CAB PRESS ind - 3.0-3.25 psia	2	
AC		rh CAB PRESS RELF vlv - BOOST/ENTR	325	
CP		02 FLOW ind - ~0.24 lb/hr	2	Verifies cabin pressure regulator lockout.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SUIT PRESS ind - 3.5-4.0 psia	2	Verifies suit demand pressure regulator aneroid function.
AC		rh CAB PRESS RELF vlv - DUMP	325	
CP		CAB PRESS ind - 0.0 psia (within 6 min)	2	Cabin at 0.01 psia within 4.5 minutes.
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
	b.	Using Side Hatch Cab Press Dump Vlv		
DP		CAB FANS - OFF (verify)	2	
CP		EMER CAB PRESS sel - OFF	351	
AC		REPRESS PKG vlv - OFF	326	
		If lone crewman oper REPRESS PKG vlv - FILL		REPRESS PKG valve should be in FILL position for lone crewman activities, as leaving valve in OFF reduces immediate repressurization capability to ≈1.8 psia, less than amount required to sustain life if suit ruptures.
DP		REPRESS O2 vlv - CLOSE	601	
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
		DIRECT O2 vlv - close (CW) (verify)	7	
DP		CAB PRESS DUMP vlv - open (CCW - one turn)	Side hatch	Valve in open position long enough for cabin pressure to decrease to ≈3.25 psia. O2 FLOW HI light may come on prior to cabin pressure regulator lockup.
		CAB PRESS ind - 3.0-3.25 psia	2	
		CAB PRESS DUMP vlv - close (CW)	Side hatch	
		O2 FLOW ind - <0.5 lb/hr	2	Verifies cabin pressure regulator lockout and that EMER CAB PRESS selector is OFF.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SUIT PRESS ind - 3.5-4.0 psia	2	Verifies suit demand pressure regulator aneroid function.
		CAB PRESS DUMP vlv - open (CCW)	Side hatch	Full open.
		CAB PRESS ind - ≈0 psia	2	
		CAB PRESS DUMP vlv - close (CW)	Side hatch	
	5.4.12	Suit Circuit Purge of H2		
AC		DIRECT O2 vlv - OPEN (CCW) for 1 min	7	Suit circuit pressure relief valve dumps hydrogen into cabin.
CP		O2 FLOW ind - 1.0 lb/hr (pegged)	2	
		O2 FLOW HI lt - on		After 16-second time delay.
ALL		MASTER ALARM pb/lt (3) - on, push	1,3,122	
AC		DIRECT O2 vlv - close (CW)	7	
CP		O2 FLOW HI lt - out	2	
		O2 FLOW ind - 0.2 lb/hr (pegged)		
	5.4.13	Cabin Cold-Soak Operation		Secondary glycol loop placed in evaporative cooling mode, and routed only to suit circuit heat exchanger.
	a.	Activate Cold Soak		
CP		Open cool control atten pnl		Covers panel 382.
		WARNING		
		SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of CO2 odor absorber filters may result.	382	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SUIT HT EXCH SEC GLY - FLOW	382	
		SEC EVAP H2O CONT vlv - AUTO		
		Close cool control atten pnl		
[illegible]		CAB TEMP - MAN	2	
CP		PRIM CAB TEMP vlv - COLD (CW)	303	Maximum cold position.
		SEC CAB TEMP vlv - OFF (CCW)		Bypass cabin heat exchanger.
DP		ECS IND sel - SEC	2	
		SEC COOL PUMP - AC2		
		SEC GLY DISCH PRESS ind - 39-52 psig		After initiating cold-soak operation, periodic ECS monitoring check should include readings from the following secondary loop indicators: SEC GLY EVAP OUT TEMP, SEC GLY EVAP STM PRESS, SEC GLY DISCH PRESS, and SEC ACCUM QTY.
		SEC ACCUM QTY ind - 30-60%		
		SEC COOL EVAP - EVAP		
		SEC GLY EVAP OUT TEMP ind - 38°-50.5°F		
		SEC GLY EVAP STM PRESS ind		
		When boiling - 0.09-0.14 psia		
		Not boiling - >0.14 psia		
		ECS IND sel - PRIM		
		RAD PRIM OUT TEMP ind - >-20°F		
		If <-20°F		Cold soak operation is stopped until RAD PRIM OUT TEMP indicator - >0°F.
		SEC COOL EVAP - RSET for 58 sec min, then off (ctr)		
		SEC COOL PUMP - off (ctr)		
	b.	Deactivate Cold Soak		
CP		SEC CAB TEMP vlv - MAX COOL (CW)	303	
DP		CAB TEMP - AUTO	2	
		SEC COOL EVAP - RSET for 58 sec min, then off (ctr)		RSET closes steam pressure contrcl valve. Steam pressure valve requires 58 seconds from full open to full close.

CABIN COLD-SOAK OPERATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SEC COOL PUMP - off (ctr)	2	
CP		Open cool control atten pnl		
		WARNING		
		SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of C02 odor absorber filters may result.	382	
		SEC EVAP H20 CONT vlv - OFF		Valve should be left at AUTO for cold soak deactivation prior to entry.
		Close cool control atten pnl		
	5.4.14	Operation of Emergency 02 Masks		
		EMER 02 - OPEN	600	Masks stowed on aft bulkhead aft of emergency 02 unit.
ALL		Don emer 02 masks	AESB	Push mask pushbutton for continuous flow, otherwise mask is demand flow.
		Doff emer 02 masks		
CP		EMER 02 - CLOSE	600	
	5.4.15	Waste Water Tank Drain		
		BAT VENT vlv - CLOSE	252	
		H20 QTY IND sw - WASTE	2	
		PRESS RELF sel - DUMP A	352	
		Monitor WASTE H20 QTY ind - decr (5% per min)	2	
		WASTE H20 QTY ind - ≈15%		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If req to dump to 0%	2	A dump to zero could expose the suit heat exchanger to adverse pressure conditions if the WASTE TK IN vlv is not configured properly.
		POT TK IN vlv - OPEN (verify) WASTE TK IN vlv - AUTO (verify)	352	
		PRESS RELF sel - 2 BAT VENT vlv - VENT	252	
	5.4.16	Gas Separator Cartridge Servicing		
	a.	Remove separator cartridges from stowage		
	b.	Attach separator to water pistol		Female port of separator will fit on water pistol probe.
	c.	Trigger water pistol in short pulses until water is observed at separator outlet port		
	d.	Wait 10 min		Allow 10 minutes for membrane wetting.
		CAUTION Membrane can be damaged by pencils, screwdrivers, & other pointed objects.		
	e.	Use separator on water pistol or food prep unit as req		

GAS SEPARATOR CARTRIDGE SERVICING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.4.17 Primary Glycol Evaporator Operation		
AC	1	Activate prim evap GLY EVAP H2O FLOW - AUTO GLY EVAP STM AUTO - AUTO	2	
	2	Deactivate prim evap GLY EVAP H2O FLOW - off (ctr) GLY EVAP STM AUTO - MAN GLY EVAP STM INCR - INCR for 58 sec		INCR position is momentary. Steam pressure valve requires 58 seconds from full open to full close.
		5.4.18 Cabin Leak Check		Procedure to be performed just prior to each rest period following completion of eating and overboard dumps.
CP	1	OVBD DRAIN vlv - OFF	251	
		WASTE STOW VENT vlv - CLOSE (verify)	252	
AC		CAB PRESS RELF vlv (2) - NORM (verify)	325	
		PRESS EQUAL vlv - CLOSE (verify)	Fwd hatch	
		TUNL VENT vlv - DM/CM ΔP (verify)	12	
	2	DIRECT O2 vlv - OPEN (CCW) until CAB PRESS ind - 5.7 psia	7	
AC	3	DIRECT O2 vlv - CLOSE (CW)		Cabin pressure decay data will be monitored by ground crew.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5.4.19	VTR Suit Hose Utilization		
		Installation		
AC		1h SUIT FLOW - FULL FLOW (verify)	301	Use LH crewmen umbilical and/or center crewmen's umbilical.
		Remove suit return hose screen cap and stow		
		Install suit hose interconnect on return hose		
		Connect supply hose to ctr fitting on VTR		Center fitting is the normal use position. Use side fitting also when additional cooling is required.
		Removal		
		Disconnect suit hose from VTR fitting		
		Remove suit hose interconnect from return hose		
		Install suit return hose screen cap		

VTR SUIT HOSE UTILIZATION

5.5 CAUTION AND WARNING SYSTEM

CAUTION

Any or all of the system status lights should not be left illuminated for more than 10 min or overheating of the matrix will occur.

Syste. management procedures for the C&WS consist of the following:

1. A procedure is provided for an operational test of the detection unit, system status lights, and MASTER ALARM pb/lt and tone. Test may be conducted at any time during mission at the discretion of crew.

2. An inhibit function is provided on panel 201 for signals that cannot be inhibited otherwise. Individual switches are provided to inhibit separate signal inputs to each of the C/W lamp indicators. These can be used to extinguish continuously-illuminated C/W lamp indicators, and to retain the C/W function of those with multi inputs by inhibiting the parameter that initially illuminated the indicator.

3. Acknowledgement of a C/W indication is performed by resetting of the master alarm circuit. The procedures apply during prelaunch or any flight phase of the mission. The Acknowledge Mode may be used to prevent excessive on-time of status lights which will become hot to touch if illuminated for more than 10 minutes.

4. A procedure is provided for adjusting and disabling master alarm tone in each headset, at the discretion of crew.

5. Memory function provides an indication of origin of those signals routed through memory.

6. A list is provided showing the C/W light input function, its associated inhibit switch and matrix light, and whether it is retained in memory.

7. A list is provided showing C/W lamps that may illuminate during normal operations.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.5.1 C&WS Operational Check		
CP		C/W LAMP TEST - 1 (hold)	2	Position 1 is momentary. Lamp test of MASTER ALARM light on panel 122 is accomplished with the G&N COND LAMP - TEST switch on panel 122. Master alarm tone not activated by this test.
AC		MASTER ALARM pb/lt - on	1	Panel 1 master alarm is disabled when C/W NORM switch is in BOOST mode and cannot be tested.
CP		lh C/W lts (18) - on	2	
		C/W LAMP TEST - 2 (hold)		Position 2 is momentary.
AC		MASTER ALARM pb/lt - out	1	
CP		lh C/W lts (18) - out	2	All lights may not be out following release of lamp test switch due to pre-existing malfunctions or conditions.
DP		MASTER ALARM pb/lt - on	3	
CP		rh C/W lts (18) - on	2	
		C/W LAMP TEST - rel		
DP		MASTER ALARM pb/lt - out	3	
CP		rh C/W lts (18) - out	2	All lights will not extinguish following release of lamp test switch if there are pre-existing malfunctions or conditions.
		C/W CSM - CM		MASTER alarm tone activated by this test.
		CM RCS lt (both) - on		Systems 1 and 2 status lights.
ALL		MASTER ALARM lb/lt (3) & tone - on	1,3,122	MASTER ALARM light on panel 1 will not come on if C/W NORM switch is in BOOST position and cannot be used for reset under this condition.
		MASTER ALARM pb/lt - push		
		MASTER ALARM lb/lt (3) & tone - out		

C&WS OPERATIONAL CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		C/W CSM - CSM CM RCS lt (both) - out C/W MEMORY - RSET	2	
	5.5.2	Dark Adaptation Adjustment		Use if desired.
		C/W NORM - ACK (at sunset) C/W NORM - NORM (at sunrise)		
	5.5.3	Acknowledge/Reset Master Alarm Indication		
ALL	a.	Normal Mode (C/W NORM in NORM) MASTER ALARM pb/lt (3) & tone - on	1,3,122	
		MASTER ALARM pb/lt (3) - push		All MASTER ALARM lights have reset capability. Pushing any light will reset alarm circuit unless C/W NORM switch in BOOST position. In this case, there is no reset capability with MASTER ALARM light on panel 1.
		MASTER ALARM pb/lt (3) tone - out		
CP		Applicable C/W lt - remains on	2	C/W light remains on until malfunction corrected.
		C/W MEMORY - RSET		
	b.	Acknowledge Mode (C/W NORM in ACK) MASTER ALARM pb/lt (3) and tone - on	1,3,122	Mode can be used during sleep periods to preclude C/W lite illumination due to a malfunction to retain darkness adaptation.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC,DP	MASTER ALARM pb/lt (2) - push and hold	1,3	MASTER ALARM light on panel 122 does not have capability.
ALL	MASTER ALARM pb/lt (3) & tone - out	1,3,122	
CP	Applicable C/W lt - on, for malfunction indication	2	
AC,DP	MASTER ALARM pb/lt (2) - rel	1,3	
CP	Applicable C/W lt - out	2	Light may be recalled by again holding MASTER ALARM light on panel 1 or 3 as long as out of limits condition exists and is not inhibited.
	If no C/W lt on		
	C/W NORM - NORM		
	C/W MEMORY - RECALL (hold)		Recalls any signals in memory.
	Any of the following may illuminate:		
	GLYCOL FLOW LOW, CRYO PRESS, FC1, FC2, FC3, O2 TK1 HTR TEMP, O2 TK 2 HTR TEMP		
	Troubleshoot applicable system(s)		
	C/W MEMORY - RSET		Clears signals from memory and resets memory for subsequent operation.
	5.5.4 Master Alarm Tone Headset Control		
	a. Headset tone disable		
ALL	PWR (3) - AUDIO	9,10,6	Disable function may be selected individually or in any combination.
	b. Permit tone		
	PWR (3) - AUDIO/TONE		

MASTER ALARM TONE HEADSET CONTROL

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	b. Permit tone PWR (3) - AUDIO/TONE	9,10,6	
	c. Tone level adjust Individually vary tone level of each audio center by screwdriver adjustment	223	Tool W (ratchet) and tool 2 (screwdriver).
	5.5.5 C/W Memory Operation		
CP	C/W PWR - 1 or 2 (verify) C/W MEMORY - RSET	2	RSET position is momentary. C/W memory - reset enables the memory power supply. C/W light on until C/W memory is reset following selection of power supply 1 or 2.
	To recall associated C/W alarms C/W NORM - NORM C/W MEMORY - RECALL		RECALL position is momentary.
	Any number of the following lights will illuminate as C/W MEMORY sw is held in RECALL if inputs have been out of limits since last C/W MEMORY - RSET operation GLYCOL FLOW LO lt CRYO PRESS lt O2 TK 1 HTR TEMP lt O2 TK 2 HTR TEMP lt FC1 lt FC2 lt FC3 lt		
	To clear signals from memory C/W MEMORY - RSET		Extinuishes applicable C/W lights and resets memory to again accept signals.

NORMAL/BACKUP

5.5.6 C/W Lights/Inhibit Memory Switch Matrix

The following list defines all CSM C/W light input functions, out-of-limit displays, associated inhibit switches, and C/W matrix lights. Asterisk adjacent to C/W light in last column denotes C/W signal input to memory. Underlined C/W lights have multi inputs, each of which can be inhibited to retain continued use of the C/W light.

System	C/W Function	Out-of-Limit Display		Manual Inhibit			C/W Light (Panel 2)
		Nominal Trigger Values	Indicator	Panel	Switch	Panel	
Misc	C/W Power Fail (CDU or memory power supply	<+11.7 or >+13.9 vdc < for +12 vdc pwr <-11.7 or >-13.9 vdc for -12 vdc pwr	None	-	None	-	C/W
	Crew Alert	Ground Command (STDN UDL)	None	-	1A	201	CREW ALERT
EPS	Inv 1 Temp High	>190°F	None	-	1B	201	INV 1 TEMP HI
	02 TK1 HTR TEMP HI	>350°F	SYS TEST (10C)	101	1C	201	*02 TK1 HTR TEMP HI
	02 TK2 HTR TEMP HI	>350°F	SYS TEST (11C)	101	1D	201	*02 TK2 HTR TEMP HI
	MNA Undervolt	<25.6 vdc	DC VOLTS	3	MNA RSET - OFF	3	MN BUS A UV
	MNB Undervolt	<25.6 vdc	DC VOLTS	3	MNB RSET - OFF	3	MN BUS B UV
	AC Bus 1 Fail	<95 or >130 vac	AC VOLTS	3	AC1 RSET - OFF	3	AC BUS 1
	AC Bus 2 Fail	<95 or >130 vac	AC VOLTS	3	AC2 RSET - OFF	3	AC BUS 2
	AC Bus 1 Overload	3Ø at 27.7 amps for 15±5 sec 1Ø at 11 amps for 5±1 sec	AC VOLTS	3	AC1 RSET - OFF	3	AC BUS 1 OVLD
	AC Bus 2 Overload	3Ø at 27.7 amps for 15±5 sec 1Ø at 11 amps for 5±1 sec	AC VOLTS	3	AC2 RSET - OFF	3	AC BUS 2 OVLD

System	C/W Function	Out-of-Limit Display: Nominal Trigger Values	Out-of-Limit Display: Indicator	Manual Inhibit: Panel	Manual Inhibit: Switch	Manual Inhibit: Panel	C/W Light (Panel 2)
	AC Bus 2 Overload	3Ø at 27.7 amps for 15+5 sec 1Ø at 11 amps for 5+1 sec	AC VOLTS	3	AC2 RSET - OFF	3	AC BUS 2 OVLD
	SM Power Disconnect	Fwd current 75 amps Rev current 4 amps 1-10 sec	DC AMPS	3	Appropriate SM PWR SOURCE - OFF	3	SM PWR DISC
CRYO	O2 Tank 1 Press	<800 or >950 psia	CRYO O2 PRESS 1	2	2A	201	CRYO PRESS
	O2 Tank 2 Press	<800 or >950 psia	CRYO O2 PRESS 2	2	2B	201	
	H2 Tank 1 Press	<200 or >270 psia	CRYO H2 PRESS 1	2	2C	201	
	H2 Tank 2 Press	<200 or >270 psia	CRYO H2 PRESS 2	2	2D	201	
FC	FC 1 Cond Exh Temp	<150 or >175°F	FC COND EXH TEMP	3	3A	201	*FC 1
	FC 1 Skin Temp	<360 or >475°F	FC SKIN TEMP	3	3B	201	
	FC 1 pH Factor	pH factor >9	FC pH HI tb	3	3C	201	
	FC 1 REACS vlv closed	H2 and/or O2 vlv closure	FC REAC tb	3	3D	201	
	FC 2 Cond Exh temp	<150 or >115°F	FC COND EXH TEMP	3	11A	201	*FC 2
	FC 2 Skin Temp	<360 or >475°F	FC SKIN TEMP	3	11B	201	
	FC 2 pH factor	pH factor >9	FC pH HI tb	3	11C	201	
	FC 2 REACS vlv closed	H2 and/or O2 vlv closure	FC REAC tb	3	11D	201	

NORMAL/BACKUP

STA/T STEP		PROCEDURE		PANEL	REMARKS		
		Out-of-Limit Display		Manual Inhibit			C/W Light (Panel 2)
System	C/W Function	Nominal Trigger Values	Indicator	Panel	Switch	Panel	
	FC 3 Cond Exh Temp	< 150 or > 175°F	FC COND EXH	3	4A	201	*FC 3
	FC 3 Skin Temp	< 360 or > 475°F	FC SKIN TEMP	3	4B	201	
	FC 3 pH factor	pH factor > 9	FC pH HI tb	3	4C	201	
	FC 3 REACS vlv closed	H2 and/or O2 vlv closure	FC REACS tb	3	4D	201	
CM RCS	He Manf Press 1	< 260 or > 330 psia	CM RCS 1 He MANF PRESS	2	Always inhibited with C/W CSM - CSM	2	CM RCS 1
	He Manf Press 2	< 260 or > 330 psia	CM RCS 2 He MANF PRESS	2	Always inhibited with C/W CSM - CSM	2	CM RCS 2
SM RCS	SM RCS A Fuel Tk Press	< 145 or > 215 psia	SM RCS A FUEL TK PRESS	2	5A	201	SM RCS A
	SM RCS A Pkg Temp	< 75 or > 205°F	SM RCS A PKG TEMP	2	5B	201	
	SM RCS B Fuel Tk Press	< 145 or > 215 psia	SM RCS B FUEL TK PRESS	2	5C	201	SM RCS B
	SM RCS B Pkg Temp	< 75 or > 205°F	SM RCS B PKG TEMP	2	5D	201	
	SM RCS C Fuel Tk Press	< 145 or > 215 psia	SM RCS C FUEL TK PRESS	2	6A	201	SM RCS C
	SM RCS C Pkg Temp	< 75 or > 205°F	SM RCS C PKG TEMP	2	6B	201	

System	C/W Function	Out-of-Limit Display		Manual Inhibit			C/W Light (Panel 2)
		Nominal Trigger Values	Indicator	Panel	Switch	Panel	
SM RCS (cont)	SM RCS D Fuel Tk Press	<145 or >215 psia	SM RCS D FUEL TK PRESS	2	6C	201	SM RCS D
	SM RCS D Pkg Temp	<75 or >205°F	SM RCS D PKG TEMP	2	6D	201	
	SM RCS PSM 1 Tk Press	>215 psia	SM RCS FUEL TK PRESS	2	7A	201	SM RCS PSM 1
SPS	SPS Oxid Press	<157 or >200 psia	SPS OXID PRESS	3	7C	201	SPS PRESS
	SPS Fuel Press	<157 or >200 psia	SPS FUEL PRESS	3	7D	201	
	Pitch GMBL Dr Fail 1	Overcurrent condition (26 amp for 90 sec)	None	-	8A	201	PITCH GMBL 1
	Pitch GMBL Dr Fail 2	Overcurrent condition (26 amp for 90 sec)	None	-	8B	201	PITCH GMBL 2
	Yaw GMBL Dr Fail 1	Overcurrent condition (26 amp for 90 sec)	None	-	8C	201	YAW GMBL 1
	Yaw GMBL Dr Fail 2	Overcurrent condition (26 amp for 90 sec)	None	-	8D	201	YAW GMBL 2
ECS	CO2 Partial Press	At >7.6 mm Hg	CO2 PP	2	9A	201	CO2 PP HI
	Glycol Flow	<134 lbs/hr (prim sys)	None	-	9B	201	*GLY FLOW LO
	O2 Flow	>1.0 lb/hr for 16.5 sec	O2 FLOW	2	9C	201	O2 FLOW HI
	Suit Compr ΔP	ΔP at inlet & outlet <0.25 psid	SUIT COMPR ΔP	2	9D	201	SUIT COMPR
SCS	BMAG 1 Temp	<168 or >172°F	None	-	10A	201	BMAG 1 TEMP
	BMAG 2 Temp	<168 or >172°F	None	-	10B	201	BMAG 2 TEMP

NORMAL/BACKUP

System	C/W Function	Out-of-Limit Display		Manual Inhibit			C/W Light (Panel 2)
		Nominal Trigger Values	Indicator	Panel	Switch	Panel	
G&C	CM Computer	• Loss of prime power • Scaler fail • Counter fail • SCADBL - scaler stage >200 pps • Parity fail • Interrupt too long or infrequent • TC trap - too few or too many TC or TCF instructions • Night watchman • Voltage fail 4 volt - <3.6 or >4.4 vdc 14 volt - <12.5 or >16.0 vdc 28 volt - >22.6 vdc • Oscillator stops • (Deleted	CMC lt RESTART & PNGS lt	122 2&140	10C	201	CMC
	Inertial Subsystem	• IMU fail • PIPA fail • CDU fail	ISS lt PROG & PNGS lt	122 2&122	10D	201	ISS

CAUTION AND WARNING SYSTEM

STA/T STEP	PROCEDURE	PANEL	REMARKS

5.5.7 Normal Operation C/W Master Alarms

The following list denotes those C/W lamps which may illuminate during normal operation. In all cases except SM C/W lights at CM/SM separation, push the MASTER ALARM pb/lt to clear the MASTER ALARM before proceeding to corrective action.

C/W Lamp (panel 2)	Remarks	Corrective Action
SM PWR DISCONNECT	Occurs momentarily when connecting fuel cell or descent battery to bus.	None
SM RCS A, B, C, & D SPS PRESS	Occurs at CM separation from SM because C/W CSM switch at CSM position.	C/W CSM - CM; MASTER ALARM pb/lt - push
SM RCS A, B, C, & D	Low temperature may illuminate light while on pad. Quad heaters are off at this time. High temperature may illuminate light during: (1) Boost heating, (2) ΔVs using SM RCS extensively with SIVB attached, or (3) transposition and docking using SM RCS extensively. During phase (1), master alarm on panel 1 inactive. During phases (2) or (3), normal operating ranges on indicators should be utilized.	Use appropriate inhibit switch to avoid nuisance alarms
O2 FLOW HI	Occurs (1) during cabin purge, and (2) if urine dump valve is left open. May occur during urine dump.	(1) C/W INPUT 9C - INHIBIT (panel 201) (2) Close urine dump valve.
CYRO PRESS	Limits may shift under flight conditions and cause low-limit warning during sleep periods.	Use appropriate inhibit switch to avoid nuisance alarms, if desired.
BMAG 1 TEMP BMAG 2 TEMP	Occurs during power up.	BMAG PWR switch (panel 7) should be left in WARMUP until the light extinguished.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	5.6 TELECOMMUNICATIONS		
	The T/C system will be in operation throughout entire mission. The information and procedures included here consist of normal and backup procedures that will be utilized to accomplish mission requirements and satisfy test objectives. Some of these procedures will only be required during tests or contingencies.		
	Most orbital paths will involve passage over several STDN ground stations within acceptable slant ranges for S-band voice and data communications. Equipment necessary for voice communications, PCM, and TLM transmission will be activated and operating at all times. The UDL will also remain activated and capable of receiving up-data when required.		
	Action required of crew for voice communications and transmission of real-time PCM TLM will be to ensure optimum radiation and reception of RF signals, either by maintaining SC attitude such that selected antenna is directed toward STDN station or by changing antennas or antenna attitude with S-band antenna controls. Also, audio control panels (MDC-6, -9, and -10) must be set up in accordance with requirements of individual crewman for control of voice transmission and reception.		
	The reception of up-data for updating the CTE and receiving real-time commands (RTCs) will require no action on part of crew since the UDL will normally remain activated and will utilize the same antenna as that used for S-band voice and data operations. For updating command module computer, however, up-telemetry switches (panels 2 and 122) must be set to ACPT position.		
	The following procedures are presented with the assumption that appropriate electrical buses are powered and that proper circuit breakers are closed.		
	5.6.1 Basic Switch Configuration		
DP	1 Apply A-C power TELCOM GRP 1 - AC1 TELCOM GRP 2 - AC2	4	

STA/T	STFP	PROCEDURE	PANEL	REMARKS
ALL	2	Audio panel (3)		Each crewman's individual audio panel must be activated to enable him to receive or transmit voice signals. T/R position enables voice transmission and reception over selected audio channel. RCV position permits reception only.
		MODE (3) - INTERCOM/PTT	9,10,6	
		S BD (3) - T/R		
		S BD VOL tw (3) - as req		
		SUIT PWR (3) - OFF		
		AUDIO CONT (3) - NORM		
		PWR (3) - AUDIO/TONE		
		MASTER VOL tw (3) - as req		
		VHF AM (3) - T/R		
		VHF AM VOL tw (3) as req		
		INTERCOM (2) - T/R	9,10	
		CM/RMTE INTERCOM - T/R	6	Intercomm between CM, DM, and Soyuz.
		CM/RMTE INTERCOM VOL tw - as req		
		VHF FM/PAD COMM (3) - T/R	9,10,6	
		VHF FM/PAD COMM VOL tw (3) - as req		
AC		VHF RNG - NORM	9	
		PHONE/MIC CONNECT - OFF	10	
CP	3	Speaker/Icom Box		ICOM position is momentary.
		XMIT/ICOM - off (ctr)	98	
		POWER - ON		
		VOL tw - as req		
		SPKR/HEADSET - SPEAKER		
DP	4	S band norm		Whenever S BD XPNDR switch is positioned from PRIM to SEC or from SEC to PRIM, hesitate momentarily in OFF position to allow relay actuation to follow switch action. S-band phaselock will be lost upon switching to alternate transponder. Phaselock must be re-established.
		S BD XPNDR - PRIM	3	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		S BD PWR AMPL PRIM - PRIM S BD PWR AMPL HI - HI S BD MODE VOICE - VOICE S BD MODE PCM - PCM S BD MODE RNG - RNG	3	
	5	S band aux S BD AUX TAPE - ctr S BD AUX TV - ctr		
	6	Up TLM UP TLM DATA - DATA UP TLM CMD - NORM PWR AMPL tb - gray		Gray indicates power applied to S-band power amplifier.
	7	S Band antenna S BD ANT OMNI A - B S BD ANT OMNI - RMTE		
	8	VHF AM VHF AM A - SIMPLEX VHF AM B - off (ctr) VHF AM RCV - off (ctr) VHF AM SQLCH tw (2) - noise +1		In event marginal VHF voice communications experienced and VHF voice communication required, VHF receiver squelch may be disabled by setting appropriate thumb-wheel to 1. This will allow weak-signal reception, but will severely degrade DSE recorded voice.
	9	VHF BCN - OFF VHF RNG - OFF		

BASIC SWITCH CONFIGURATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	10	Tape recorder		
DP		TAPE RCDR PCM - PCM/ANLG	3	
		TAPE RCDR RCD - RCD		
		TAPE RCDR FWD - FWD		
		TAPE MOTION tb - gray		Gray indicates tape in motion.
	11	Power		
		SCE PWR - NORM		
		PMP PWR - NORM		
	12	TLM inputs		
		PCM BIT RATE - LO		
	13	VHF ANT - SM LEFT		
	14	S BD SQLCH - ENBL		
	15	VTR Power up		
CP		TLM POWER - ON	400	
		INTRLVR POWER - ON		
		VTR POWER - ON		
		HD WHL DP MOT - ctr		
		TAPE MODE - ctr		
		TAPE DRIVE - ctr		
		TAPE HD CLEAN - NORMAL		
		LAMP TEST - STATUS		
	16	TV		
		VIDEO PWR - OFF	426	
		VIDEO SOURCE - CM		
		VICEO TV MODE - PLAYBACK		

BASIC SWITCH CONFIGURATION

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	17	DM & Soyuz TV Power up Prep		
DM		DM 1 TV STATION POWER - OFF	808	
		DM 2 TV STATION POWER - OFF		
		CAMR SYNC - CM/DM		
		TV STATION SEL DM/SOYUZ - UP TLM		
		TV STATION SEL DM1/DM2 - UP TLM		
		CAMR SYNC - UP TLM		
	5.6.2	VHF/AM Modes		Basic switch configuration provides CSM-STDN voice and CM-recovery voice.
		Simplex A		
		Select Basic, 5.6.1		
		Duplex A		Should not be used until after CSM/SIVB separation as STDN transmission on VHF AM B will interfere with booster TM.
		Select Basic, except		
DP		VHF AM A - DUPLEX	3	
		Simplex B		CM-recovery backup voice. Should not be used until after CSM/SIVB separation as STDN transrission on VHF AM B will interfere with booster TM.
		Select Basic, except		
		VHF AM B - SIMPLEX		
		VHF AM A - off (ctr)		
		Duplex B		
		Select Basic, 5.6.1, except		
		VHF AM B - DUPLEX		
		VHF AM A - off (ctr)		
		RCV ONLY A		Provides capability to monitor recovery VHF voice transmissions.
		Select Basic except		
		VHF AM RCV - A		
		VHF AM A - off (ctr)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.6.3 VHF/FM Modes		
		VHF FM Simplex Select Basic, 5.6.1		
DP		VHF FM/AM Duplex	3	
ALL		VHF AM (3) - RCV	6,9,10	
		VHF FM/PAD COMM VOL tw - full decr		
		5.6.4 VHF AM Ranging Mode		
		VHF AM A - off (ctr) VHF AM B - DUPLEX VHF RNG - on (up) If P20 operating VHF AM rng option selected		
CP		TRACKER lt - on	2,140	CMC will activate TRACKER light and wait for a "data good" signal from digital ranging generator.
AC		EMS - VHF RNG EMS MODE - VHF RNG EMS FUNC - VHF RNG	1	
		CAUTION		
		There must be no VHF AM voice transmission by CSM or STDN for ≈12 sec after VHF RNG - RSET.	9	Voice transmission at this time could interfere with the accuracy of ranging signal.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		VHF RNG - PSET (1 sec min)	9	PSET position is momentary, hold for 1 second minimum. When VHF RNG switch placed to PSET, RNG indicator will reset to zero, and operator will hear mid tone (3.95 kHz) and then low tone (247 Hz).
		RNG ind - BBBBO O (read BBBB0.0)	1	
		If P20 operating VHF AM rng option selected		
CP		TRACKER lt - out	2,140	TRACKER light - out (no OCDU failure) and RNG indicator starts counting up 4 seconds after termination of low tone. RNG indicator interpreted as range in nautical miles to nearest .XXNM.
AC		RNG ind - BXXXX X (read BXXX.XX)	1	
	5.6.5	Pad Communications		
		Select Basic, 5.6.1 except		
DP		TAPE RCDR FWD - off (ctr)	3	
		Prior to launch		
ALL		VHF FM/PAD COMM (3) - T/R (or RCV)	9,10,6	VHF FM/PAD COMM switch can be used after launch for intercom backup with VHF FM/PAD COMM VOL thumbwheel decreased.
		VHF FM/PAD COMM VOL tw (3) - as req		
		Launch -10:00		
		VHF FM/PAD COMM (3) - OFF		
	5.6.6	S-Band Xponder Modes		
		Voice, RT-HBR Data, Ranging		
		Sel Basic, 5.6.1 except		
ALL		PCM BIT RATE - HI	3	
		Voice, RT-LBR Data, Ranging		
		Sel Basic		
		Voice, RT-HBR Data		
		Sel Basic, except		
		S BD MODE RNG - OFF		
		PCM BIT RATE - HI		

S-BAND XPONDER MODES

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Voice, RT-LBR Data Sel Basic, except		
DP	S BD MODE RNG - OFF	3	
	Voice & Ranging Sel Basic, except S BD MODE PCM - ctr		
	Voice Sel Basic, except S BD MODE PCM - ctr S BD MODE RNG - OFF		
	Voice & LBR PCM with Apollo Range Instrumentation Aircraft (ARIA) Sel Basic, except S BD MODE RNG - OFF		
	5.6.7 FM Xmtr Mode		
	Dump PCM/Analog Sel Basic, 5.6.1 except TAPE RCDR FWD - REWIND S BD AUX TAPE - TAPE TAPE RCDR RCD - PLAY TAPE RCDR FWD - FWD (after rewind complete) TAPE MOTION tb - gray Rewind & return to Basic		Gray indicates tape in motion.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	5.6.8 DSE Record Modes		Under nominal conditions STDN will control tape recorder operation. If degraded data is experienced by STDN, then the DSE should be operated 4 seconds in fast forward mode prior to recording flight data on the initial footage of tape.
DP	Record HBR CM Data, CM/IC, DM/IC, EXP/PCM Data Sel Basic, 5.6.1 except PCM BIT RATE - HI	3	
	Record LBR CM Data, CM/IC, DM/IC, EXP/PCM Data Sel Basic		
	5.6.9 Relay Mode (VHF FM to MCC-H via SBD)		
CP	Select Basic, 5.6.1, except MODE - VOX VOX SENS tw - 8 VHF FM/PAD COMM - RCV VHF FM/PAD COMM tw - 5 S BD VOL tw - full decr PWR - AUDIO MASTER VOL tw - 3 INTERCOMM VOL tw - full decr VHF AM - OFF AUDIO CONT - BU	10	
	5.6.10 Sleep Configuration		
DP	Select Basic, 5.6.1, except S BD - OFF	6	

SLEEP CONFIGURATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	VHF FM/PAD CONT - RCV	9	
	INTERCOMM - RCV		
AC	VHF AM - OFF		
DP	AUDIO CONT - BU	10	
	Config to Relay Mode, 5.6.9		
	5.6.11 Backup Modes		
	Up Voice Backup		Requires coordination with STDN. Updata signal (noise) will be present in headsets until STDN reconfigures for this mode.
	Sel Basic, except		
	UP TLM DATA - UP VOICE BU	3	
	Down Voice Backup		
	Sel Basic, except		
	S BD MODE PCM - ctr		
	S BD AUX TAPE - DN VOICE BU		
	S BD MODE RNG - OFF		
	PCM BIT RATE - HI		
	Down Voice & LBR RT Data Backup		
	Sel Basic, 5.6.1, except		
	S BD AUX TAPE - DN VOICE BU		
	S BD MODE RNG - OFF		
	Key		
	Sel Basic, except		
	S BD MODE PCM - KEY		
	S BD MODE RNG - OFF		
	Down Data Backup		
	Sel Basic, except		
	PMP PWR - AUX		

STA/T STEP	PROCEDURE	PANEL	REMARKS
5.6.12	TV Oper TBD		
5.6.13	TV Modes TBD		For DM TV checkout and TV crew transfers, refer to 18.5.2 and 18.5.3.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	5.7 MECHANICAL SYSTEMS		
	5.7.1 Forward Hatch Removal		
DP	Opening Fwd Hatch From CM Interior		
	Equalize CM/DM press		If required. Tunnel pressure integrity check is incorporated into these procedures.
	Actr handle rel - PULL & ROTATE	Tunl	To free actuator handle for operation, release is rotated to stop.
	Actr handle - pull to stop		Actuator handle should move ≈80°.
	Actr handle sel - U (unlatch)		
	Actr handle - push to stop		Actuator handle should move ≈60° to release latches.
	Gearbox disconnect socket - U (verify)		
	Actr handle sel - STOW		
	Actr handle - push to stowed position		Actuator handle release automatically locks handle in stowed position.
	Remove & stow fwd hatch		Hatch should be stowed in LHEB.
	5.7.2 Forward Hatch Installation		
DP or CP	Closing Fwd Hatch From CM Interior		Performed by DP or CP.
	Obtain fwd hatch from stowage	Fwd	Forward hatch stowed in LHEB.
	Position hatch against sealing surface	hatch	Align equivalent colored arrows.
	Actr handle rel - PULL & ROTATE		To free actuator handle for operation, release rotated to stop.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP or CP		Actr handle - pull to stop	Fwd hatch	Actuator handle should move ≈80°.
		Actr handle sel - L (latch)		
		Actr handle - push to stop		Actuator handle should move ≈60° to engage latches.
		Verify gearbox disconnect socket is opposite L mark on hatch		
		Actr handle sel - STOW		
		Actr handle - push to stowed position		Actuator handle release autoratically locks handle in stowed position.
		Push man gearbox lock (chrome tab)		Verifies that gear box lock is engaged.
AC		PRESS EQUAL vlv - CLOSE (CW)		Yellow indicator pin must be in green zone and valve handle must be in yellow-band area (indicates valve is fully closed).
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Cannot close PRESS EQUAL vlv Remove fwd hatch, 5.7.1 Insert Tool B in external tool interface for additional leverage, hold depressed & rot (CCW) Install fwd hatch		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	5.7.3	Forward Hatch Seal Integrity Check		
		Secure tunl hatches		
		Verify DM hatch is closed & vlv properly set		
CP		CAB PRESS ind - 4.7-5.3 psia (verify)	2	

FORWARD HATCH SEAL INTEGRITY CHECK

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Install fwd hatch, 5.7.2		
	Read O2 FLOW ind	2	
	TUNL VENT vlv - TUNL VENT for 30 sec, then DM/CM ΔP & check ΔP incr	12	
	TUNL VENT vlv - TUNL VENT until ΔP >-3.5 psi		
	DM/CM ΔP ind - remains constant within ±0.2 psi at last value read for 2 min (verify)		
	O2 FLOW ind - no incr (verify)	2	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	O2 FLOW ind - incrs and/or		
	DM/CM ΔP ind - ΔP decr	12	
	O2 FLOW ind remains stable, DM hatch is probably not integral		
	O2 FLOW ind - incrs, CM fwd hatch is probably not integral		
	Pressurize tunl using PRESS EQUAL vlv	Fwd hatch	
	Open fwd hatch, 5.7.1		
	Check for foreign object(2) jammed in tunl/hatch seal interface or hatch seal damage		
	Close fwd hatch, 5.7.2		
	Reinitiate steps (secure tunl hatch & check integrity		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		TUNL VENT vlv - TUNL VENT for >10 min	12	
		TUNL LT - OFF	274	
	5.7.4	Docking Probe Removal		
	1	Panel and tunnel configuration		
AC		PROBE (3) - OFF	2	PROBE EXTD/REL switch is guarded.
		cb DOCK PROBE (2) - open	8	
CP		Fwd hatch removed, 5.7.1	tunl	
	2	Verify extend latch engaged, ind (red) not visible		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If extend latch not engaged, indicator (red) not flush with latch housing		
		Preload sel lever - rotate CW (away from orange stripe)		
		Preload handle - torque CCW until extend latch engages, indicator (red) not visible		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		GN2 bleed button (red) - press (10 sec)	tunl	GN2 bleed button (red) located under pyro components cover, depressurizes probe retract system when depressed.

DOCKING PROBE REMOVAL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Preload sel lever - rotate CCW (parallel to orange stripe)	tunl	
		Preload handle - torque CW until load removed from support beams		Support beams may become loose in docking ring sockets.
	3	Disconnect & stow probe umbilicals		
		Pull first connector shell (yellow) & rotate CCW to unlock		
		Pull connector to remove		Stowage connector located on aft side of support beams.
		Align yellow mark with stowage connector (yellow) & push to engage		
		Rotate connector shell CW to lock		
		Repeat for second probe umbilical (yellow)		
		Close probe umbilical connector covers (2) (yellow)		
		Position preload handle against stowed probe umbilical		
		Preload sel lever - place to mid-position		
	4	Fold probe		
		Pull instal strut from clip on support bear, rotate foot 180° & position against tunl wall between yellow marks		
		Depress ratchet handle rel buttor (gray) & pull ratchet handle aft to full extension		Ratchet handle rel button (gray) is on aft end of ratchet handle.

5.7.4 DOCKING PROBE REMOVAL

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Depress ratchet handle rel button (gray) & push ratchet handle to first detent (red band only visible) Push ratchet handle outboard 30° & hold allowing probe to fold	tunl	Probe fully folded when Teflon block on Z-support beam within 1/4 inch of ratchet housing.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Probe will not fold Using tool F, rotate jam nut & hex bolt (ratchet handle stop) CCW to remove bolt Push ratchet handle outboard until probe releases & hold until probe folds (Subs instal of probe must be done very carefully to avoid releasing ratchet & folding probe while attempting to install it)		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Depress ratchet handle rel button (gray) & pull ratchet handle aft to full extension Push ratchet handle outboard 25° for one stroke only Depress ratchet handle rel button (gray) & with ratchet handle held inboard, push fully fwd to stow position Rotate instal strut foot 180° to stow position & restow instal strut in clip on support beam		

DOCKING PROBE REMOVAL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	Release probe from drogue		
		Remove capture latch rel tool (tool 7) from stowage	tunl	For stowage, reference NASA document (TBD).
		Insert tool into pyro cover guide bushing		
		Rotate tool 180° CW and hold to unlock		
		Grasp probe support handle & pull aft to rel probe from drogue		≥25 pounds pull required to release probe.
		If probe will not rel from drogue		
		Pull instal strut from clip on support beam, rotate foot 180° & position against tunl wall between yellow marks		
		Depress ratchet handle rel button (gray) & pull ratchet handle aft to full extension		
		Push ratchet handle outboard 25° to stop & repeat until support beams engage docking ring sockets		
		Rotate preload sel lever CCW (parallel to orange strip)		
		Rotate capture latch rel tool 180° CW & hold		
		Torque preload handle CW until capture latches release from drogue		
		Fold probe, step 4		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Verify capture latch cocked (plunger recessed below probe head cap) Remove and stow capture latch rel tool Remove probe from tunl & stow as req	tunl	For stowage, reference NASA document (TBD).
		5.7.5 Docking Probe Installation		
	1	Panel and tunnel configuration PROBE (3) - OFF (verify) cb DOCK PROBE (2) - open	2 8	PROBE EXTD/REL switch guarded.
AC CP		Drogue installed, 5.7.8		
	2	Remove probe from stowage		
	3	Engage capture latches Push probe head into drogue until capture latches engage & lock		A slight pull in aft direction will disengage capture latches if not fully engaged.
	4	Engage probe in docking ring Pull instal strut from clip on support beam, rotate foot 180° & position against tunl wall between yellow marks		Yellow marks located on -Z axis. Probe support beam and corresponding docking ring socket color-coded yellow.
		Depress ratchet handle rel button (gray) and pull ratchet handle aft to full extension (green & red bands visible) Push ratchet handle outboard 25° to stop & repeat until probe support beams (3) engage in docking ring sockets		Ratchet handle release button (gray) on aft end of ratchet handle. From this point ≈19 strokes required to install probe. An orange hash mark on collar conduit becores visible when fully installed. Care should be exercised to to ensure probe support beams (3) align with docking ring sockets and end of pitch arms do not interfere with docking latch fairings.

DOCKING PROBE INSTALLATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If pushing ratchet handle outboard does not advance support beams to engage docking ring sockets		
CP	Depress ratchet handle rel button (gray) & push ratchet handle fwd to first detent (red band only visible)	tunl	
	Slowly push ratchet handle outboard 25° until ratchet pawl engages (audible click) & repeat until 3 probe support beams engage in docking ring sockets		If ratchet pawl not audible, watch action of ratchet pawl indicator (red).
	(If ratchet handle pushed outboard past point of pawl engagement, probe will release)		
	Verify ratchet pawl ind (red) flush with ratchet housing		
	If ratchet pawl ind protruding above ratchet housing		
	Push ratchet handle outboard 25° to stop & hold		
	Press ratchet pawl ind (red) to seat pawl (ind flush)		
	Return ratchet handle to full inboard position		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Depress ratchet handle rel button (gray) & with ratchet handle held inboard, push fully fwd to stow position Rotate instal strut foot 180° to stow position & restow instal strut in clip on support beam	tunl	
	5	Adjust preload handle in direction req to maintain support beams in an unloaded condition		This step required only if probe installed in tunnel for stowage. Support beams may become loose in docking ring sockets. Rotate preload sel lever CCW (parallel to orange stripe) to move extend latch aft (compress probe) and CW (away from orange stripe) to move extend latch fwd (expand probe).
		Position preload handle at 45° angle to support beam (either side)		Position provides clearance with fwd hatch actuator handle.
	6	Push preload shaft fwd into detent		
	7	Connect probe umbilicals		This step not required when installing probe for stowage.
		Pull probe umbilicals covers (2) (yellow) inboard & rotate fwd to open		Probe umbilical covers located in docking ring.
		Pull first connector shell (yellow) aft & rotate CCW to unlock Pull connector to remove Align with docking ring connector (yellow) & push to engage Rotate connector shell CW to lock Repeat for sec probe umbilical (yellow) GN2 bleed button (red) - press (10 sec)		Probe umbilical connectors are stowed on probe support beams.

DOCKING PROBE INSTALLATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.7.6 Docking System Probe Extension and Status Check		
AC		cb DOCK PROBE (2) - close (verify)	8	
		CAUTION PROBE EXTD/REL should not be held in EXTD/REL position longer than 20 sec if probe has not extended. Capability of capture latch release motors may be degraded.		
CP		PROBE EXTD/REL - EXTD/REL and hold until probe fully extended PROBE EXTD/REL tb (2) - gray to bp to gray PROBE RETR (2) - OFF (verify)	2	Guarded. EXTD/REL position is momentary. Probe extended by compression spring and attenuator airhead forces. Crew should readily sense by auditory cues that probe has extended when probe strikes stops. Crew may not see talkbacks go barber pole because of rapid probe motion. Barber pole indicates power to tb through probe circuitry. Return to gray indicates full extension of probe.
		PROBE EXTD/REL - RETR		Guarded.
		PROBE EXTD/REL tb (2) - gray (verify)		Verifies capture latches not locked and probe fully extended or capture latches not locked and probe has partially extended (3/4 inch).

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	PROBE POSITION / PROBE EXTD/REL sw POSITION: EXTD/REL / RETR FULL EXTD: gray / gray FULL RETR: bp / bp PARTIAL EXTD: bp / gray		Probe position indications.
	5.7.7 Docking Drogue Removal		
CP	Docking probe removal, 5.7.4	tunl	
	Pull & rotate (CCW) drogue lock lever until flush against tunl wall		
	Remove drogue		
	Drogue outer ring is grasped with both hands at opposite sides		
	Rotate (CW) & push until 3 drogue lugs clear support fittings		Care must be taken not to stroke DM hatch.
	Rotate toward CM & grasp any 2 handles		
	Mnvr drogue past support fittings & stow in CM		Drogue must be canted and rotated to clear tunnel. For stowage, reference NASA document (TBD).
	5.7.8 Docking Drogue Installation		
	Procure drogue from stowage		

DOCKING DROGUE INSTALLATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Install drogue	tunl	
	Mnvr past support fitting DM tunl		Drogue must be canted and rotated to clear support fittings in tunnel. Limited clearance between DM hatch and support fittings requires care in maneuvering drogue if closed. Handles should be used for support.
	Align drogue lugs (3) with support fittings in DM tunnel		Drogue must be held along outer diameter at opposite sides adjacent to drogue lugs. At this point drogue handles are facing DM hatch.
	Pull drogue lugs into support fittings & rotate (CCW) until lugs hit stops in support fittings		Ramps on support fittings will guide drogue lugs into support fitting recesses.
	Push & rotate drogue latch lever 90° (CW)		Locks drogue latch mechanism.
5.7.9	Probe Preload Operation		
	Rotate preload select lever CCW (parallel to orange stripe)		
	Torque preload handle CW until load limiter releases		Preload handle extension may be telescoped outboard to provide additional leverage if required.
	Push preload handle inboard to detent & position at 45° angle to support bear (either side)		Position provides clearance with fwd hatch handle.
	Rotate preload sel lever to mid-position		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5.7.10	Tunnel Latch Operations		
CP	1	Verify probe is preloaded, 5.7.9	tun1	
	2	Cocking of latches		Any suitable tool may be used to trigger release lever if desired.
		WARNING To avoid possible injury to fingers or damage to PGA, care must be taken not to place fingers under or near a latch while cocking, nor under or near the latch hook of a cocked latch.		
		Depress rel button behind handle latch grip & pull latch handle down two complete strokes		This procedure disengages and cocks latch. It may take only one complete stroke to cock each latch.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If latch handle cannot be pulled While pulling handle, depress rh no-back pawl on bottom until it disengages from ratchet tooth If latch handle pulls free, remove pressure from rh no-back pawl & complete cocking procedures If latch handle still cannot be pulled While pulling handle, depress lh no-back pawl through fairing covering hole with tools E & R until ratchet tooth disengages & latch handle pulls free		

TUNNEL LATCH OPERATIONS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Remove pressure from lh no-back pawl & complete cocking procedure	tunl	
		If latch handle still cannot be pulled Remove fairing covering lh no-back pawl (using tools E & R) While pulling handle, depress both no-back pawls on bottom until ratchet teeth are disengaged & latch handle pulls free Remove pressure from both no-back pawls & complete cocking procedure		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Verify hook rotates inboard to clear DM ring		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If latch hook does not release from DM ring on first stroke Push top of AUX REL (yellow) button & proceed with sec stroke		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Verify/push latch handle outboard against latch hook		Prevents latch handle sticking inboard which could prevent latch primary trigger from resetting after undocking.
	3	Repeat 2 until all 12 latches are disengaged & cocked		Latches reset for subsequent docking operations.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	Manual triggering of latches Push manual release lever at side of latches	tunl	This procedure engages latch. Manual release lever located at lower right side of latch handle. Use tool L to push manual release lever.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.8 FLOODLIGHT OPERATING MODES		
		5.8.1 Prim Floodlight Mode		
ALL		FLOOD LTS - OFF (CCW) FLOOD DIM - 1 FLOOD LTS - full dim or full BRT	5,8,100	
		5.8.2 Sec Floodlight Mode		Operation in secondary mode is a backup only to be used in the event of DIM-1 circuitry in-flight failure. The DIM-2, dimmed floodlight predicted operating life is ≈100 hours.
		FLOOD LTS - OFF (CCW) FLOOD DIM - 2 FLOOD LTS - full BRT (CW)		

5.8.2 SEC FLOODLIGHT MODE

NORMAL/BACKUP

6.0 G&C REFERENCE DATA

This section provides data which generally apply to all G&C procedures in sections 7 through 21. The data do not include procedures but contain information which may be referenced in various procedures, may contain application of procedures, or may be helpful in applying the procedures.

6.1 G&C OPERATING NOTES

G&C operating notes are separated into three categories: G&C operations, SCS operations, and G&N operations. Notes for G&C operations provide data associated with guidance and control functions in general while notes for SCS and G&N operations are more specific to their systems.

6.1.1 G&C Operations

1. ULLAGE: For ullage switch setup with or without attitude control, see figure 6-1. Normally, the setup should include attitude control.

2. RCS JET, VENT, RADIATOR, AND ANTENNA LOCATIONS: SM and CM RCS jets, vent, and radiator locations are illustrated in figure 6-2.

3. SCS LOGIC BUS POWER DISTRIBUTION: SCS logic bus circuit breakers on panel 8 provide MTA and MNB power to four SCS logic buses. Figure 6-3 delineates power source and power distribution for SCS controls (pushbuttons, functions, and switches).

   Main bus power to SCS logic buses 1 and 4 is controlled only by the SCS logic bus circuit breakers on panel 8. Power to SCS logic buses 2 and 3 is controlled by SCS logic bus circuit breakers on panel 8 and the LOGIC 2/3 PWR switch on panel 7. Other than SCS TVC, equipment loads can only be removed from a specific logic bus by selecting acceptable control positions not powered by that bus. (See figure 6-3.)

   For SCS logic bus power loss and SCS logic bus power loss (special effects), see figures 6-4 and 6-5.

4. AC/DC BUS LOSS: Figure 6-6 relates ac and dc bus loss effects to G&C component functional capabilities. As shown, a functional capability may be only partially lost, or lost entirely.

Type of Ullage Desired		Required AUTO RCS Switch Positions (Jets Firing*)								RCS Jets* Providing Attitude Hold Capability	
		Pitch				Yaw					
		A3	C3	A4	C4	B3	D3	B4	D4	Pitch	Yaw
2 Jet-Quad A/C Pitch Jets C3 and A4	Without Attitude Control	OFF	MNA or MNB	MNA or MNB	OFF	MNA or MNB	OFF	OFF	MNA or MNB	None	B3 and D4
	With Attitude Control	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	OFF	OFF	MNA or MNB	A3 and C4	B3 and D4
2 Jet - Quad B/D Yaw Jets B3 and B4	Without Attitude Control	MNA or MNB	OFF	OFF	MNA or MNB	OFF	MNA or MNB	MNA or MNB	OFF	A3 and C4	None
	With Attitude Control	MNA or MNB	OFF	OFF	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	A3 and C4	B3 and D4
4 Jet - Quad ABCD Jets A4, B4, C3, D3	Without Attitude Control	OFF	MNA or MNB	MNA or MNB	OFF	OFF	MNA or MNB	MNA or MNB	OFF	None	None
	With Attitude Control	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	A3 and C4	B3 and D4

*See figure 6-2 for explanation of jet code.

Figure 6-1. SCS Ullage Setup

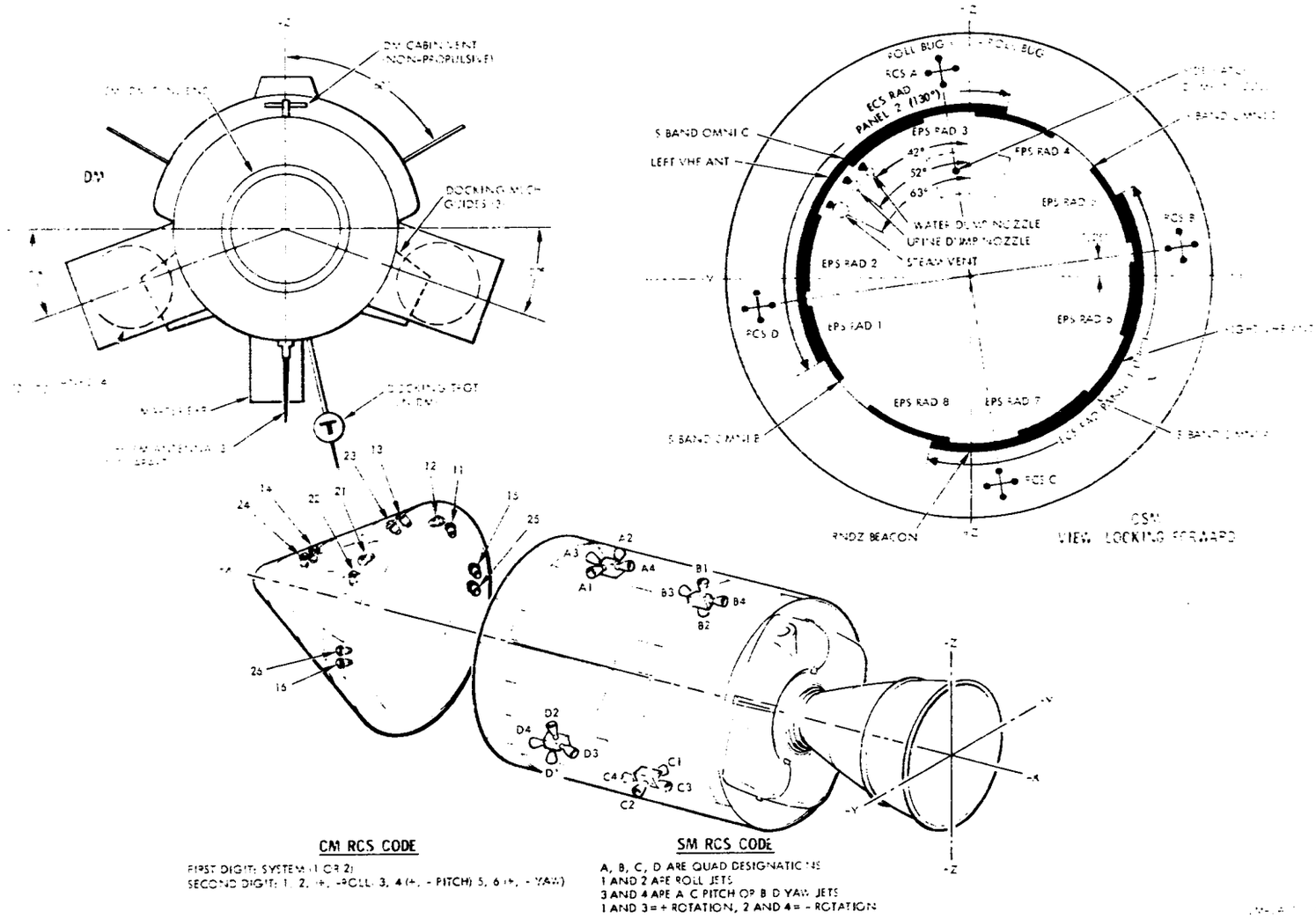

Figure 6-2. RCS Jet, Vent, and Radiator Locations

NORMAL BACKUP

CONTROLS		POWER SOURCE				POWER OFF	
TITLE	POSITIONS	BUS 1 (cb direct)	BUS 2 (LOGIC 2/3 PWR sw)	BUS 3 (LOGIC 2/3 PWR sw)	BUS 4 (cb direct)	OPEN CIRCUIT	SWITCHED OFF BY
CMC ATT	IMU	X			X		cb SCS LOGIC 1/2, 1/4, & 3/4
	GDC					X	
FDAI SCALE	5/1					X	
	5/5		X				LOGIC 2/3 PWR
	50/15/50/10				X		cb SCS LOGIC 1/4 & 3/4
FDAI SEL	1/2				X		cb SCS LOGIC 1/4 & 3/4
	1			X			LOGIC 2/3 PWR
	2			X			LOGIC 2/3 PWR
FDAI SOURCE	CMC		X				LOGIC 2/3 PWR
	ATT SET			X			LOGIC 2/3 PWR
	GDC			X			LOGIC 2/3 PWR
ATT SET	IMU		X				LOGIC 2/3 PWR
	GDC				X		cb SCS LOGIC 1/4 & 3/4
MAN ATT (3)	ACCEL CMD	X					cb SCS LOGIC 1/2 & 1/4
	RATE CMD					X	
	MIN IMP	X					cb SCS LOGIC 1/2 & 1/4
LIM CYCLE	on (up)					X	
	OFF	X					cb SCS LOGIC 1/2 & 1/4
ATT DBD	MAX					X	
	MIN	X					cb SCS LOGIC 1/2 & 1/4
RATE	HI	X					cb SCS LOGIC 1/2 & 1/4
	LO					X	

Figure 6-3. SCS Logic Bus Power Distribution (Sheet 1 of 2)

CONTROLS		POWER SOURCE				POWER OFF	
TITLE	POSITIONS	BUS 1 (cb direct)	BUS 2 (LOGIC 2/3 PWR sw)	BUS 3 (LOGIC 2/3 PWR sw)	BUS 4 (cb direct)	OPEN CIRCUIT	SWITCHED OFF BY
SC CONT	CMC		X				LOGIC 2/3 PWR
	SCS			X			LOGIC 2/3 PWR
BMAG MODE	RATE 2		(R)	(P & Y)			LOGIC 2/3 PWR
	ATT 1/RATE 2		(R)	(P & Y)			LOGIC 2/3 PWR
	RATE 1	(R,P,Y)					cb SCS LOGIC 1/2 & 1/4
DIR ULL	pb	X					cb SCS LOGIC 1/2 & 1/4
THRUST ON	pb	X					cb SCS LOGIC 1/2 & 1/4
SBC ALIGN	pb				X		cb SCS LOGIC 1/4 & 3/4
SCS TVC (2)	AUTO			X			LOGIC 2/3 PWR
	RATE CMD			X			LOGIC 2/3 PWR
	ACCEL CMD			X			LOGIC 2/3 PWR
ATVC GAIN	LO			X			LOGIC 2/3 PWR
	HI					X	LOGIC 2/3 PWR
EMS ROLL	on (up)				X		cb SCS LOGIC 1/4 & 3/4
	OFF					X	
.05 G sw	on (up)				X		cb SCS LOGIC 1/4 & 3/4
	OFF		X				LOGIC 2/3 PWR
TVC GMBL DR (2)	1					X	
	AUTO	X					cb SCS LOGIC 1/2 & 1/4
	2			X			LOGIC 2/3 PWR
THC	CW sw		X				LOGIC 2/3 PWR

Figure 6-3. SCS Logic Bus Power Distribution (Sheet 2 of 2)

CAUTION

SCS logic bus power must not be removed from CMC ATT switch if (1) pitch or yaw rate >5°/second, or (2) GDC yaw Euler angle >80° and <280°. Removing power when either of these conditions exist will result in GDC damage.

5. LIMITED USE CONTROLS: G&C circuit breakers, required for G&C operation, are to be closed during the entire mission except in event of malfunctions. (See figure 6-7.) If a malfunction occurs, some circuit breakers may be operated in order to isolate problem areas. Refer to malfunction **procedures in Flight Data File (FDF).**

   Figure 6-8 defines switches which will remain in same position during major portion of orbital flight time because of functional requirements. Other considerations are to maintain maximum crew safety, increase equipment reliability, and minimize power consumption.

6. ATT SET - IMU FUNCTION: If CMC is on, an overload in IMU resolver circuitry may cause an ICDU oscillation and trigger the ISS warning light (Reference ICD MH01-01325-210). FDAI must be used only as a null meter in this mode of operation. If not, large errors will result because of impedance mismatch. ATT SET switch should be left at GDC when not in use.

   A polarity reversal occurs when ATT SET - IMU option is selected, and roll gimbal angle >±90°. The pitch and yaw attitude error needles become "fly from" indicators rather than "fly to" indicators in this instance.

7. LOGIC 2/3 PWR switch: Required "on" for proper control/display functions (G&N or SCS modes). See figure 6-3 for switches whose positions are dependent on this switch being on for proper system operation.

8. MANEUVER >17°: For CMC maneuvers >17° and during SIVB or Soyuz maneuvers, the BMAGs should be caged to prevent them from hitting their stops.

CONTROL	SCS LOGIC BUS POWER LOSS							
	BUS 1		BUS 2		BUS 3		BUS 4	
	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT
FDAI SCALE			5/5	5/1 50/15			50/15	5/5 5/1
FDAI SEL					1 & 2	1/2	1/2	1 2
FDAI SOURCE			CMC	GDC ATT SET	ATT SET GDC	CMC		
ATT SET			IMU	GDC			GDC	IMU
MAN ATT (3)	ACCEL CMD MIN IMP	RATE CMD						
DIM CYCLE	OFF	on (up)						
ATT DED	MIN	MAX						
RATE	HI	LO						
CMC			CW	neutral				
ST CONT			CMC	CMC	SCS	CMC		
EMAG MODE (3)	RATE 1	ATT 1/RATE 2 RATE 2	(R) RATE 2 ATT 1/RATE 2	(R) RATE 1	(P,Y) RATE 2 ATT 1/RATE 2	(P,Y) RATE 1		
DIR ULL pb	push (logic only)	———						
THRUST ON pb	push							
GDC ALIGN							push	———
SCS TVC (2)					all	———		
ATVC GAIN					LO	HI		
EMS ROLL							on (up)	OFF
.05 G sw			OFF	OFF			.05 G	OFF
TVC GMBL DR (2)	AUTO	1 2			2	1 AUTO		

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Figure 6-4. SCS Logic Bus Power Loss

NORMAL BACKUP

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
CMC CONTROL MODE (SC CONT - CMC)	• No effect	• CMC attitude control may exist since G&N power not affected by LOGIC BUS 2 short • ACCEL CMD (CMC) lost	• No effect	• No effect
RCS CONTROL	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage
	SCS/SM RCS: • Control modes restricted to positions shown for BUS 1 corrective action, figure 6-4	SCS/SM RCS: • P & Y not affected • For manual roll BMAG MODE (R) - RATE 1 MAN ATT (R) - RATE CMD, ACCEL CMD or MIN IMP • For SCS att hold (R) BMAG MODE (R) - ATT 1/RATE 2 LIM CYCLE - on (up)	SCS SM/CM RCS: • MAN ATT (3) - ACCEL CMD operational (CMC or SCS) • MAN ATT (3) - MIN IMP operational if THC - CW • MAN ATT (R) - RATE CMD operational if THC-CW & SC CONT - CMC • MAN ATT (P,Y) - RATE CMD operational if THC-CW & BMAG MODE - RATE 1 or ATT 1/RATE 2 & LIM CYCLE - on (up)	SCS/SM RCS: • No effect
	SCS/CM RCS: • Use direct RCS only • Disable auto RCS RCS CMD - OFF or AUTO RCS (12) - OFF • Use single ring only	SCS/CM RCS: • P & Y not affected • Roll axis BMAG MODE (R) - RATE 1 MAN ATT (R) - RATE CMD or ACCEL CMD • .05 G function operational		SCS/CM RCS: • Roll to yaw coupling loss for post .05 G

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Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 1 of 4)

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
SPS CONTROL	Gimbal Control: • SCS auto TVC functional • MTVC rate cmd functional with: BMAG MODE (P,Y) - ATT 1/RATE 2 or RATE 2 • No direct ullage (for logic) • ACCEL CMD operational • THC-CW operational • If servo 1 failure TVC GMBL DR (2) - 2	Gimbal Control: • SC CONT - CMC (simultaneous CMC & SCS TVC occurs) • CMC ΔV capability exists if: SCS TVC (2) - ACCEL CMD SCS trim to 0.0° • THC-CW switchover function lost - switch to 2 by TVC GMBL DR (2) - 2	Gimbal Control: • SCS auto TVC lost • MTVC - Rate cmd operational with RATE 1 only • Accel cmd operational with RATE 2 (P,Y) • Manual switch to servo 2 with TVC GMBL DR - 2 is lost - Use: TVC GMBL DR (2) - AUTO THC-CW	Gimbal Control: • No effect
	Thrust on/off: • CMC thrust on not affected • Ullage - THC +X or DIR ULL as backup (no direct ullage for logic function) • SCS thrust on SPS THRUST - on (up) only • SCS thrust termination ΔV THRUST A (B) - OFF	Thrust on/off: • No effect	Thrust on/off: • CMC thrust on not affected • THRUST ON pb operational if THC-CW • ΔV ind operational (for thrust termination)	Thrust on/off: • No effect

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Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 2 of 4)

NORMAL BACKUP

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
THC	• No effect	• THC-CW function lost - use SC CONT - SCS	• No effect	• No effect
DISPLAYS	Pre/Post .05 G: • All displays operational except RATE 1 (No source for rate display or for att ref)	Pre- .05 G: • FDAI SEL - 1/2 operational except (ball 2) att error • CMC source (ball 1) operational except CDU error • Total att, att error (ball 2) lost if: FDAI SOURCE - CMC FDAI SEL - 2 • Att error lost if: FDAI SOURCE - ATT SET ATT SET - IMU • FDAI SCALE - 5/5 lost • Yaw rate display indicates roll coupling • R & P rate display normal • BMAG R, P, Y att error (ball 2) lost if: FDAI SEL - 1/2 or FDAI SOURCE - GDC	Pre/Post .05 G: • FDAI SEL - 1/2 operational • FDAI SEL - 1 & 2 lost (for both CMC or GDC) • FDAI SOURCE - ATT SET function lost • All displays (rate, att error, total att) valid for FDAI SEL - 1/2 only • BMAG 1 & 2 rate valid	Pre/Post .05 G: • FDAI SCALE - 50/15 lost • FDAI SEL - 1 or 2 only • FDAI SOURCE - CMC or GDC operation • GDC & RSI align lost

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Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 3 of 4)

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
		Post .05 G: • FDAI SEL - 1/2 operational • Ball 1 - CMC source operational • Ball 2 - CMC source lost • SCS - total att, rate display, att errors normal		Post .05 G: • Display of roll to yaw coupling not void (actual coupling does not exist)

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Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 4 of 4)

G&C COMPONENT	G&C FUNCTIONS LOST OR MODIFIED BUS LOSS AC1	AC2	MNA	MNB
BMAG 1	• Rate • Error		• SMRD, C/W, htr • Error	
BMAG 2		• Rate		• SMRD, C/W, htr
REC 1	• Rate cmd		• 1/2 dir jets (full auth - MNA/MNB) • All dir jets (1/2 auth or full auth - MNA)	• 1/2 dir jets (full auth - MNA/MNB)

Figure 6-6. AC/DC Bus Loss (G&C Effects) (Sheet 1 of 2)

G&C COMPONENT	G&C FUNCTIONS LOST OR MODIFIED BUS LOSS AC1	AC2	MNA	MNB
RHC 2		• Rate cmd	• 1/2 dir jets (full auth - MNA/MNB)	• 1/2 dir jets (full auth - MNA/MNB) • All dir jets (1/2 auth or full auth - MNB)
ECA	• Min impulse • Att hold • Rate damping • RHC 1 rate cmd • SCS auto ΔV • RHC 1 MTVC	• Rate cmd • MTVC • Att hold | No BMAG 2 rate • Auto ΔV |	• Att hold | No BMAG 1 error • Auto ΔV |	• Min impulse (42 msec)
GDC	• R,P,Y att • FDAI roll align	• R,P,Y att • FDAI pitch, yaw align • Roll stab att (RSI)	• R,P att	• Y att • Roll stab att (RSI)
ORDEAL		• Pitch (lcl horiz) att		• Pitch (lcl horiz) att
EDA (FDAI,GPI)	• FDAI 1 (R,P,Y att, rate, error) • GPI 1 (P,Y)	• FDAI 2 (R,P,Y att, rate, error) • GPI 2 (P,Y)	• FDAI 1 (R,P,Y att)	• FDAI 2 (R,P,Y att)
RJEC (RCS)			• Yaw dir ULL jets (D3/B4) • CM RCS 1 auto jets (prior CM/SM sep)	• Pitch dir ULL jets (C3/A4) • CM RCS 2 auto jets (prior CM/SM sep)
SPS			• Bank A • GMBL mot P1, Y1	• Bank B • GMBL mot P2, Y2

Figure 6-6. AC/DC Bus Loss (G&C Effects) (Sheet 2 of 2)

The G&C circuit breakers listed in this chart must be closed throughout the mission except when necessary to correct a malfunction.

Panel 8
- SCS
  - TVC AC1
  - AC (both)
  - ECA/TVC AC2
  - CONTR DIR (4)
  - A/C ROLL (2)
  - B/D ROLL (2)
  - PITCH (2)
  - YAW (2)
  - CONTR AUTO (2)
  - LOGIC BUS 2/3 & 3/4
  - SYS (2)
- ORDEAL (2)
- RCS
  - SM HTRS (4)
  - PRPLNT ISOL (2)
- EMS (2)
- SPS (all except)
  - Gauging (4)

Panel 5
- G/N
  - LTS (both)
  - IMU (2)
  - IMU HTR (2)
  - CMPTR (2)
  - OPT (2)

Panel 229
- EPS
  - GRP 1 (both)
  - GRP 2 (both)
  - GRP 3 (both)
  - GRP 4 (both)
  - GRP 5 (both)

Figure 6-7. Limited Use G&C Circuit Breakers

Switch	Location	Position Major Portion of Mission	When Required	Remarks
CMC ATT	MDC-1	IMU	Normally not touched.	Selection of GDC position causes total attitude display to be lost on both balls. Must not be moved to GDC position if (1) pitch or yaw rate is >5°/sec, or (2) GDC yaw Euler angle is >80° and <280°. GDC damage will result if this is done.
IMU CAGE (guarded)	MDC-1	off (down)	To establish an inertial reference in event of CSS failure or IMU tumbling.	Cage mode zeros the IMU gimbals in a coarse alignment.
EMS ROLL	MDC-1	OFF	Prior to entry.	Refer to Entry and Entry Preparation procedures.
.05 G sw	MDC-1	OFF	At .05 G during entry.	Except for entry, on (up) position is not desirable (cages BMAGs). Off position powered by LOGIC 2/3 PWR - on (up).
Pc IND sw	MDC-1	Pc	Normally not touched	Left in Pc position during entire mission.
LV IND/GPI sw	MDC-1	GPI	Prior to SPS thrusting.	Placed in SIVB position during Prime Crew Prelaunch check. Temporarily placed in GPI position for SPS gimbal check during boost phase.

Figure 6-8. Limited Use Controls (Sheet 1 of 2)

Switch	Location	Position Major Portion of Mission	When Required	Remarks
LV GUID	MDC-2	IU	If inputs to SIVB control system via CMC are required.	Nonfunctional after separation from SIVB.
UP TLM	LEB-122	ACPT	Not normally changed.	Both UP TLM switches (MDC-2, LEB 122) must be in ACPT position for CMC to accept telem data. MDC-2 switch is normally used as control.

Figure 6-8. Limited Use Controls (Sheet 2 of 2)

9. ACCEL CMDs: Acceleration commands are available, via RHCs, any time MAN ATT switches are at ACCEL CMD (SC CONT - CMC or SCS). However, ACCEL CMD position inhibits any CMC outputs to RCS jets.

10. EMS MODE switch: EMS MODE switch should be placed to NORM <30 seconds prior to thrusting. Buildup of ΔV indicator errors, caused by accelerometer bias, minimized if this is done. Errors also minimized if set to STBY immediately after thrusting. Otherwise, ΔV ind continues counting.

11. MAN ATT/BMAG MODE switches: Switches may be set by axis, as desired.

12. SPS GMBL MOTORS: Start motors sequentially at ≈1-second intervals to avoid electrical overload. Turn GMBL MOT switches OFF sequentially to avoid power surge. Turning servo 2 off first minimizes switching in the logic.

13. (R02) IMU STATUS check: Procedure prerequisites signify when ISS should be on and a known orientation required. Assuming that prerequisites have been complied with, program alarm for R02 should not occur. If prerequisites are not complied with, program alarm for ISS not on and/or IMU orientation unknown is treated as shown in 8.1.16.

14. CMC ATT switch: Normally left at IMU position throughout mission. Selection of GDC position causes total attitude display to be lost on both balls. GDC damage will result if GDC position selected and pitch or yaw rate is >5°/sec, or if GDC yaw Euler angle is >80° and <280°.

15. COAS: During COAS installation or removal, verify COAS PWR switch (panel 15) is OFF. If COAS reticle lamp power is lost, the crew penlight may be used for the reticle light source. Ensure that COAS PWR switch (panel 15) is OFF. Remove COAS light bulb; insert and tape penlight in receptacle. Dimming of the reticle may be achieved by tilting penlight away from the longitudinal axis of the COAS.

16. DIGITAL AUTOPILOTS (Docked and Undocked): The Docked RCS DAP (DDAP) will normally be activated (via V45E) only when CSM is docked to the Soyuz; otherwise Undocked RCS DAP (UDAP) will be activated (via V46F). Figure 6-12 describes Docked and Undocked functional differences and capabilities. R03 and R04 are the load routines used with the Undocked and Docked DAPS respectively.

17. **COORDINATE SYSTEM: Figure 6-13 depicts the CSM/DM/SOYUZ cluster coordinate systems. Additionally, the rotations produced by various jet schemes are shown.**

6.1.2 SCS Operations

1. SCS RATE/DEADBAND: During SCS attitude control modes (4.7.1), ATT DBD and RATE switch positions establish rate and deadband response. (See figure 6-9.) For FDAI scaling, see figure 6-10. Refer to 8.2.1 for selection of CMC controlled rate and deadband.

2. SCS JET SEL: Sixteen AUTO RCS switches, consisting of four switch groups titled A/C ROLL, B/D ROLL, PITCH, and YAW with four switches each, enable CM and/or SM jets. Panel nomenclature for AUTO RCS switches summarizes jet characteristics for both SM and CM RCS jets. See figure 6-11. Refer to 6.1.3, note 1d, and 8.2.1 for CMC jet selection.

3. INADVERTENT JET FIRINGS: When powering up SCS, BMAGs should be caged to prevent inadvertent firings of RCS jets.

4. PSEUDO RATE: The pseudo rate function, controlled by LIM CYCLE switch, is used only during SCS attitude hold mode to conserve RCS propellants. However, manual SCS maneuvers with LIM CYCLE switch on cause excessive RCS injector valve cycling and increased propellant consumption. Switch does not function when in computer (CMC) mode. Also refer to note 6.

5. SIG CONDR/ER BIAS PWR switch: Powers RJEC -4 vdc bias power supplies and various SCS signal conditioners for telemetery. To provide increased reliability, switches should not be set on same bus.

6. LIM CYCLE switch: For SCS modes, LIM CYCLE switch should be configured as follows in order to conserve RCS propellant:

   OFF - Manual proportional rate command.
   OFF - Automatic rate damping.
   on (up) - Attitude hold.

7. BMAG PWR switch: When BMAG PWR switches set to OFF, 40-minute warmup may be required (BMAG 1 & 2 TEMP lights out when operating temperature reached) for optimum operation of BMAGs. However, meaningful rate information is available immediately from cold BMAGs. If set from ON to WARMUP, BMAG TEMP lights should remain out.

NORMAL BACKUP

8. RHC's (interchange): Interchanging of RHC No. 2 with RHC No. 1 to Support an Operational Failure of RHC No. 2 during Mission.

   a. Remove RHC No. 1 and RHC No. 2 from couch armrests by releasing lock and pawl assembly.

   b. Remove cable from six restraints on couch beam starting from controller end.

   c. Loosen handle/clamp which secures couch to beam and disengage couch from clamp (R.H. and L.H. couch).

   d. Remove cable from remaining restraints to connect on junction box.

   e. Install RHC No. 1 to right hand armrest of commander's couch and secure with pawl and lock assembly.

   f. Install RHC No. 2 to left hand armrest of communication couch and secure with pawl and lock assembly.

   g. Route cable utilizing the eleven restraints on each beam and strut supports in configuration as removed.

   h. Reinstall couch in clamp located on couch beam and secure with clamp/handle.

   i. From strut establish a cable service loop approximately 10 inches in diameter atop wire tray and secure with tape as necessary.

9. RHC's (push-to-talk interchange): If the push to talk capability for the No. 1 RHC is desired, the connectors at the junction box must be interchanged since this function is not available electrically at the junction box for RHC No. 1 position. To implement this, the following procedure should be followed in addition to the above procedure for switching RHC's.

   a. Remove RHC connector shroud covers (P1 and P2) attached to the SCS junction box using tool E (stowage item).

   b. Select the off position of the normal and direct switches (2 each) on Panel No. 1 prior to demating connectors.

   c. Disconnect both connectors and remate to opposite receptacles.

   d. Reinstall connector covers using tool E.

   e. Route cables along front side ($+Z_C$) of junction box shroud and secure both cables with strap provided.

   f. Set direct and normal switches to on position.

Control Parameter		SWITCH POSITIONS			
		RATE - LOW*		RATE - HIGH	
		ATT DBD:		ATT DBD:	
		MIN	MAX*	MIN	MAX
Attitude Deadband		±0.2°	±4.2°	±4.0°	±8.0°
Commanded Rates	Pitch & Yaw	±0.7°/sec		±7.0°/sec	
	Roll			±20.0°/sec	
Rate Deadband		±0.2°/sec		±2.0°/sec	

*Recommended position to minimize fuel consumption during attitude hold.

Figure 6-9. SCS Rate and Deadband Select Logic

FDAI SCALE SW POS	FLIGHT PHASE	ATT ERROR		SCS RATES
		CMC	SCS	
5/1	Boost & entry	R 20° P&Y 5°	RP&Y 5°	RP&Y 1°/sec
	All other	RP&Y 5°	RP&Y 5°	RP&Y 1°/sec
5/5	Boost & entry	R 20° P&Y 5°	RP&Y 5°	RP&Y 5°/sec
	All other	RP&Y 5°	RP&Y 5°	RP&Y 5°/sec
50/15, 50/10	Boost & entry	R 50°	R 50°	R 50°/sec
		P&Y 15°	P&Y 15°	P&Y 10°/sec
	All other	R 12.5°	R 50°	R 50°/sec
		P&Y 15°	P&Y 15°	P&Y 10°/sec

Figure 6-10. FDAI Scaling

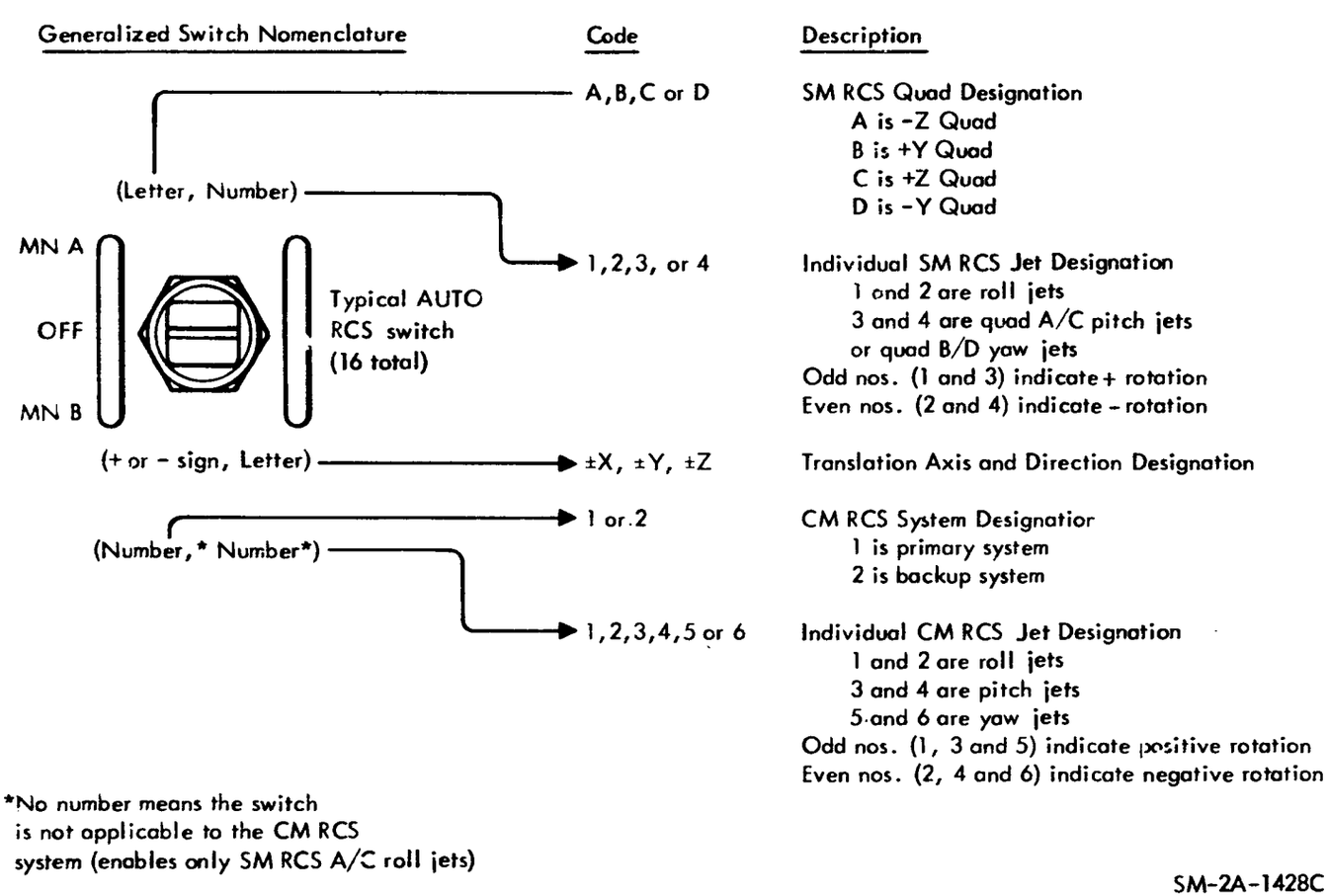
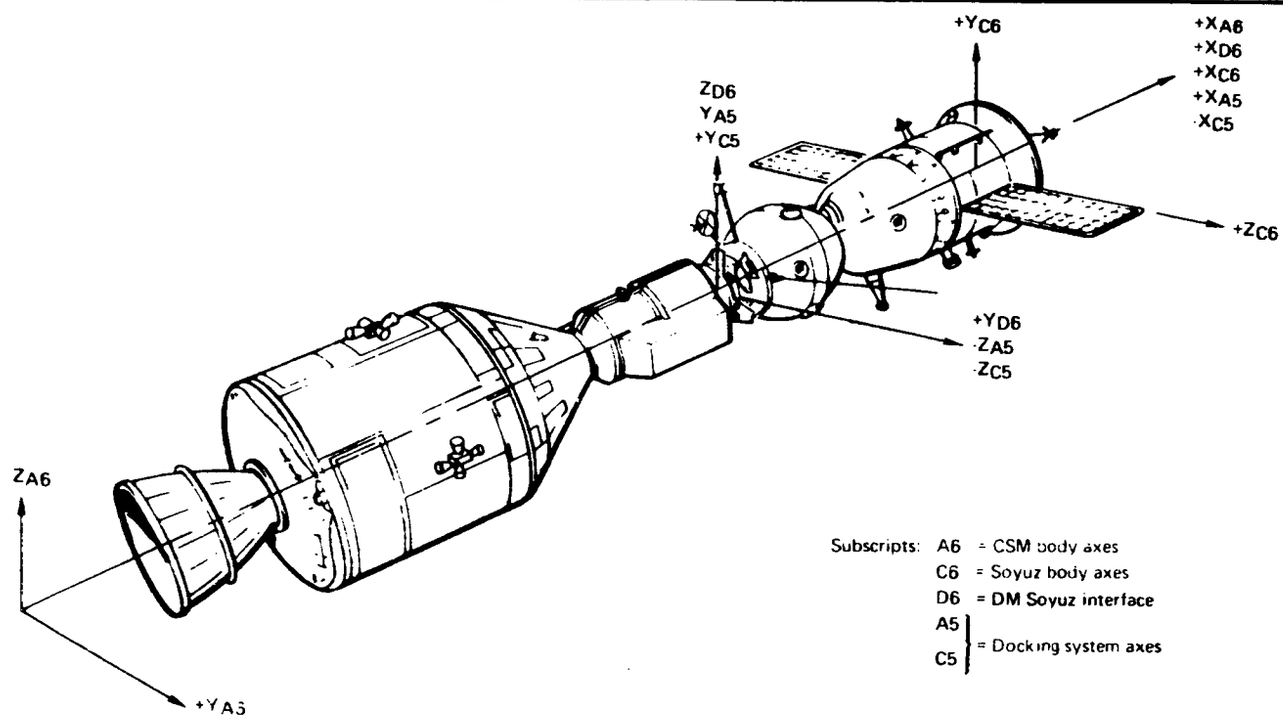


Figure 6-11. SCS Jet Select Logic: MDC-8 Nomenclature

INPUTS	MODES		
	AUTO	HOLD	FREE
GENERAL	Accepts rate and attitude commands from maneuver routine.	UDAP: Holds attitude specified by N46. DDAP: Holds attitude specified by N89.	Free drift.
RHC	UDAP: Rate commands (magnitude specified by N46) about control axes. (Inhibits auto routine.) DDAP: Rate commands (magnitude specified by N89) about control axes. (Inhibits auto routine.)	UDAP: Rate commands (magnitude specified by N46) about control axes. DDAP: Rate commands (magnitude specified by N89) about control axes.	UDAP: Minimum impulse commands (14 ms jet firing). DDAP: Acceleration commands about control axes. For pitch and yaw axes, torque couple or force pair (N87-R1) determines jets to be used for commanded acceleration.
THC	UDAP: X, Y, Z commands combined with rotation commands result in X, Y, Z translation forces to S/C (rotation has priority over translation). DDAP: Only + & -X translation commands honored.	UDAP: X, Y, Z commands combined with rotation commands result in X, Y, Z translation forces to S/C (rotation has priority over translation). DDAP: Only + & -X translation commands honored.	X, Y, Z commands combined with rotation commands result in X, Y, Z translation forces to S/C (rotation has priority over translation). When docked to Soyuz, Y, Z commands actually result in rotation because of the moment arm between CSM quad plane and cluster c.g.
MIC	Ignored	Ignored	Minimum impulse commands UDAP: (14 ms jet firing). DDAP: (50 ms jet firing).

Figure 6-12. Digital Autopilots (Docked & Undocked)



SM RCS TORQUE COUPLES ①

PITCH	YAW	A/C ROLL	B/D ROLL
+θ A3 +θ C3	+Ψ B3 +Ψ D3	+Φ A1 +Φ C1	+Φ B1 +Φ D1
θ A4 θ C4	Ψ B4 Ψ C1	Φ C2 Φ A2	Φ D2 Φ B2

SM RCS FORCE COUPLES ①

PITCH	YAW	A/C ROLL	B/D ROLL
+θ B1 +Z +θ D2	+Ψ A2 -Y +Ψ C1	+Φ A1 +Φ C1	+Φ B1 +Φ D1
θ B2 Z θ D1	Ψ A1 +Y Ψ C2	Φ C2 Φ A2	Φ D2 Φ B2

NOTE

① ROTATIONAL SENSES ARE RELATIVE TO CSM CONTROL AXES.

SM-2A-2480A

Figure 6-13. CSM/DM/Soyuz Cluster Coordinate Systems

6.1.2

6.1.3 G&N Operations

1. GENERAL:

a. IMU STBY PWR: If standby power is removed for more than 20 minutes, ISS calibration is no longer valid.

b. CMC CONTROLLED MANEUVERS: During CMC controlled maneuvers, any input from RHC (RHC out of detent) will be interpreted by CMC as a manual override and will cause immediate termination of auto maneuver calculation. During P20 if RHC is taken out of detent, V58E may be keyed to resume the CMC controlled maneuver.

c. VEC POINT ROUTINE: VEC POINT routine (all CMC auto maneuvers except P20 options 4 and 5 and in R62) may compute large rotations about pointing vector when pointing vector must be rotated 180°. Sensitivity to such changes gets greater as magnitude increases toward 180°. If desired, a manual maneuver (≈30°) may be performed and the solution is then recomputed by keying PRO on FL V50 N18 while not in CMC/AUTO.

d. CMC JET SEL: CMC jet selection is accomplished by performing procedure 8.2.1, V48 (R03, DAP Data Load) or 8.2.2, V44 (R04, docked DAP Data Load). AUTO RCS switches should correspond to RCS DAP configuration.

e. IMU GMBL LOCK: If non-G&N controlled attitude maneuvers are made by crew, care must be taken to avoid IMU gimbal lock. IMU gimbal angles may be monitored by observing ICDUs (V16 N20) or by monitoring FDAI ball. During CMC automatic maneuvers, if MGA >75°, CMC establishes attitude hold to prevent gimbal lock. Crew must manually maneuver, or provide more suitable IMU alignment.

f. CMC PWR: If computer power is switched off, it will be necessary to perform a computer fresh start (V36E) to initialize erasable storage. CMC update program (P27) would have to be done to update the state vector and computer clock time.

g. CLOCK TIME (GET): CMC is capable of maintaining an accurate value of ground elapsed time (GET) for only 23 hours when in standby mode. If CMC is not brought out of standby condition to running condition at least once within 23 hours, CMC value of GET must be updated.

h. IMU ORIENTATION (P51): Time and RCS prplnt may be saved, and subsequent IMU alignment decisions greatly simplified if P51 is performed in such a way as to leave IMU inertially stabilized at an orientation as close as possible to optimum orientation required by future CMC programs.

i. UPLINK ACTY lt: Set when uplink (P27), or in R61 if R60 desired but maneuver inhibited. Reset when ERR RSET, KEY REL, or P27 termination.

2. CSS/ISS INTERFACE: Normally the CMC must be ON before the IMU can be operated. However, the IMU may be powered up while the CMC is at STBY. In this condition, the IMU is caged (if powered up) and remains in a coarse align mode. Caging is accomplished internally and does not require any panel switching. However, if the CMC is at STBY, the IMU can be uncaged by placing the IMU CAGE switch to on (up) for ≈5 seconds. V37 should not be called for 15 seconds after NO ATT light goes out. If V37 is called prior to 15 seconds, the PIPA FAIL bit will not be reset and a PIPA FAIL will go undetected.

3. DSKY OPERATIONS: DSKY operations (MDC-2 and LEB-140) require certain restrictions to operation, loading of data, and display of data which are necessary to proper operation. Some general restrictions are listed below. Detailed information relative to DSKY operations is contained in MIT Report E-2129, "Keyboard and Display Program and Operation."

a. DISPLAY/MONITOR VERBS: For display verbs (01-07), monitor verbs (11-17), and for all load verbs (21-25), the number of components of the verb must not exceed the number of components of the noun being used beginning with noun 04. Noun 01, 02, and 03 may be used with any verb regardless of number of components. If an attempt is made to violate this restriction, the OPR ERR indicator will illuminate when ENTR is pressed to execute the verb/noun action.

b. OCTAL/DECIMAL MIXING: No mixing of octal and decimal data will be allowed for loads having more than one component. If an attempt is made to violate this restriction, the OPR ERR indicator will illuminate when ENTR is pressed for the last entry.

c. DECIMAL/OCTAL LOADS: Octal data loads require only significant digits be keyed (e.g., 5, 4, ENTR). Loading decimal data requires each complete entry be made with a sign (+, -), followed by significant digits. Decimal load of less than 5 digits will be

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accepted, just as an octal load. Zeros need not be entered ahead of most significant digit. (E.g., for a data load of +925, entry will be made by pressing DSKY keys +, 9, 2, 5, ENTR, and +, ENTR rather than +, 0, 0, 0, 0, 0, ENTR.) When loading decimal data, ENTR sometimes changes last digit of loaded value.

d. MACHINE ADDRESSES: Machine addresses must be loaded in octal.

e. DATA LOAD: If an attempt is made to load a data word which is too large in magnitude for the noun being used, the OPR ERR indicator will illuminate.

All data loads must be verified before pressing ENTR key for last register being loaded. (CLR key has no effect after last ENTR is pressed.) If any of the data is incorrect, register may be cleared by pressing CLR key. Each successive pressing of CLR key will clear preceding register until first register is cleared. (This backing up action will only operate on components called by load verb used.)

f. VERB/NOUN FLASHES: All VERB/NOUN flashes require operator action and the program in progress is halted until appropriate action is taken.

g. PROGRAM SELECTIONS: At times when program selection is not allowable by astronaut action (V37E XXE), R00 will issue a program alarm (01520) and interrupted activity will resume. Attempts to select nonexistent programs will result in an operator error light and return to interrupted program activity and display.

h. PROGRAM TERMINATION: Any program can be terminated at a flashing display via V34E except:

- P20 (except to FL V06 N49 in R22 or to FL V50 N18 in R60) can be terminated by keying P00 or V56E only. V34E on a prethrust program will turn off that program but not P20.
- V34E with an extended verb running will terminate the extended verb only.
- V34E is ignored in P06, and for response relative to N61 in P62.

STA/T STEP	PROCEDURE	PANEL	REMARKS

i. V96E: V96E may cause significant loss of W-matrix correlation if keyed in:

- After a V37E XXE from a program using average G and before XX appears in PROG lights.
- During a permanent state vector integration in P20 during mark processing.

To recover, V93E is keyed at some time prior to next navigation marks or VHF range input. In all other cases, use of V96E will cause no ill effects providing next program selected is P00.

j. V82E: After V82E, meaningful information in N50 (splash error) is available only during P11 and P00.

k. EXTENDED VERBS: Extended verbs are not restart-protected. If RESTART light goes on during an extended verb, or if software restart occurs (no RESTART light), the verb should be reselected.

l. VG/ΔV DISPLAYS: VG or ΔV displays in control coordinates, N85 or N83, are based on reading accelerometers every 2 seconds. Displays, however, are asynchronous 1-second monitors. Result is a possible 1/2- to 1-1/2-second delay between application of ΔV and visible result.

m. PRO KEY: A PRO key input is rejected if verb windows show a V21, V22, or V23. V33E must be used for these cases, e.g., a V21 PRO (or V25E PRO) will be rejected; a V25 PRO will not. For the V21, V22, V23 and PRO cases, PRO lights OPR ERR light.

n. KEY REL pb/KEY REL lt: Normal and special cases of KEY REL light and KEY REL push-button use are discussed in the following notes.

STA/T STEP	PROCEDURE	PANEL	REMARKS

KEY REL lt - on

- When internal display comes up while operator has DSKY.
- When internal flashing display is currently on DSKY and keystroke is made except for PRO, ENTR, and ERR RSET.
- Suspended monitor: When operator makes keystroke on top of (his own) monitor verbs (verbs 11-17).
- Remains on after V37 until new program is started. Operator should not use keyboard until KEY REL light is out and new program number is displayed.

c. KEY REL lt - out

- When operator relinquishes DSKY by pressing KEY REL.
- When operator terminates his current sequence normally by:

  Final ENTR of load sequence

  or ENTR, after a response to a flashing display (V34E)

  or ENTR, after an extended verb request (V49E).

p. Special cases of KEY REL

- If operator selects a nonmonitor verb display on top of his own previously selected monitor verb, the KEY REL light will flash. Pressing KEY REL will bring back (unsuspend) the monitor and extinguish light. However, if these sequences are performed on top of an internal display, the KEY REL light will not go out when KEY REL is pressed. One more KEY REL operation (total of two) is required to extinguish KEY REL light, and bring back the internal display.

- If operator selects a verb-noun combination (i.e., V16 monitor) on top of an internal flashing display, the internal display can still be answered with V32E, PRO, or V34E, which wipes everything from the DSKY until the next internal display. However, an operator-selected monitor should, as a rule, never be terminated with V34E. V34E may not be the desired response to the internal flashing display. KEY REL should be used instead. KEY REL need not be used if a data load is interrupted by a priority display.

q. N58: **N58 should not be loaded, although a data load may not generate OPR ERR.**

r. P20 (option 2): The following modes of suspension or termination have the effect shown:

MODE	EFFECT		
	DBD CENTERED	DBD SOURCE	RATES NULLED
RHC deflection	Yes	Unchanged	Yes
V56E	No	DAP (R03)	Yes
V37E 00E	No	DAP (R03)	Yes
SC CONT - SCS	Yes	SCS (Return to CMC re-establishes N79 DBD)	Yes (Return to CMC re-establishes N79 rate)
CMC MODE - FREE/AUTO	Yes	Unchanged	No
V46E	Yes	N79	No
CMC MODE - HOLD	Yes	N79	Poss jet firings
V48E, PRO	No	DAP (R03)	Poss jet firings (although not expected)
|MGA| >75°	No	Unchanged	Yes

s. PRIORITY DISPLAYS: There are three priority displays which will ignore any response for 2 seconds

V06 N49 in R22
V05 N09 in R52
V50 N18 in R60 (during P20)

4. OPTICS MECHANIZATION: Operation of the SCT and SXT requires adherence to certain constraints which are described as follows:

   a. To avoid sun interference, the sun position must be more than 10 degrees from optics shaft-drive axis and more than 15 degrees from star LOS for SXT, and more than 55 degrees from shaft-drive axis for SCT. Within these limits it is possible to use SXT even when sun position is between the SLOS and LLOS. The constraints given, however, do not take into account light scattering which can occur from actual spacecraft configuration.

   b. An adequate portion of the star field must be visible through SCT in order that navigational stars can be recognized. The optics shaft-drive axis thus must be pointed at least 30 degrees above local sunlit earth horizon and at least 20 degrees above local dark earth horizon.

   c. Maximum SXT LOS drive rates are 10 deg/sec for trunnion and 19.5 deg/sec for shaft, with a ±20 percent tolerance.

   d. TRACKER caution light should be ignored during TVC. Optics CDU fail during TVC, sets TRACKER light which will stay on (even with fail removed) until end of TVC or keying RSET.

   e. During auto optics, computation lag between sampling IMU CDUs and driving optics causes optics to lag behind target. Amount of offset is proportional to CSM angular rate. This will not cause an error during manual tracking and marking.

   f. After a fresh start, or restart, or after turning optics power on, optics must be taken out of zero and returned to zero to perform an optics zero since it is not position of switch but change to zero position that triggers zeroing program.

   g. Optics may be damaged (when zeroing) by being driven into soft or hard stops if trunnion angle >10°. To preclude possible damage, manually drive optics <10° before initiating zeroing procedure (refer to 8.1.4).

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.2 VERB LIST Regular Verbs 01 Disp oct compnt 1 (R1) 02 Disp oct compnt 2 (R1) 03 Disp oct compnt 3 (R1) 04 Disp oct compnt 1, 2 (R1, R2) 05 Disp oct compnt 1, 2, 3 (R1, R2, R3) 06 Disp dec (R1 or R1, R2 or R1, R2, R3) 07 Disp DP dec - test only (R1, R2) 11 Mon oct compnt 1 (R1) 12 Mon oct compnt 2 (R1) 13 Mon oct compnt 3 (R1) 14 Mon oct compnt 1, 2 (R1, R2) 15 Mon oct compnt 1, 2, 3 (R1, R2, R3) 16 Mon dec (R1 or R1, R2 or R1, R2, R3) 17 Mon DP dec - test only (R1, R2) 21 Load compnt 1 (R1) 22 Load compnt 2 (R2) 23 Load compnt 3 (R3) 24 Load compnt 1, 2 (R1, R2) 25 Load compnt 1, 2, 3 (R1, R2, R3) 27 Disp fixed memory 30 Request exec 31 Request waitlist		V33E must be used for accept option if V21, V22, or V23 is in verb window. PRO is not accepted and turns on OPR ERR light.

STA/T STEP	PROCEDURE	PANEL	REMARKS
32	Recycle		
33	Proceed		
34	Terminate		
35	Test lights		Use in P00 only.
36	Req fresh strt		Blanks DSKY displays. May compromise stored state vector requiring a P27 update and IMU orientation determination.
37	Change prog (major mode)		
	Extended Verbs		
*40	Zero CDU		Ensures sync between ISS CDU counters and CDU counters in CMC. Terminates coarse align and enters fine align.
41	Coarse align CDU (with N20 & N91)		N20 - Aligns IMU to gimbal angles specified by crew. To coarse align to 0, 0, 0 when GMBL LOCK and coarse align. N91 - To drive optics to shaft and trunnion angles specified by crew (V41 N91 from P00 only).
42	Fine align IMU		Pulse torque gyros.
43	Load FDAI att err needles (test only)		P00 only.
44	Strt DDAP data load		Calls routine R04. DDAP = Docked DAP.
*45	Activate DDAP		
*46	Activate UDAP		UDAP = Undocked DAP.
*47	Set Soyuz state vctr into CSM state vctr		
48	Strt UDAP data load		Calls routine R03.
49	Strt crew defined mnvr (R62)		P00 only.
	*Callable with another extended verb in use & does not lock out other extended verbs.		

VERB LIST

STA/T STEP	PROCEDURE	PANEL	REMARKS
50	Please perform		
51	Please mrk		Used in P03, R53.
53	Please mrk alternate LOS		Used in R23, R56.
54	Strt rndz backup sighting mrk (R23)		
55	Increment CMC time (dec)		
*56	Term tracking (P20)		
57	Partial/full track option		Both VHF and/or optics mark data.
*58	Rset stick flag, set V50N18 flag		Allows auto maneuvers.
*59	Enable all jets		Enables all jets previously inhibited in R04.
*60	Set att err ref to present att		N17 = N20.
*61	Sel mode 1 (disp DAP att err)		Mode 1. FDAI error needles show difference between current and DAP commanded ICDU angles.
*62	Sel mode 2 (disp tot att err)		Mode 2. Display difference between desired final ICDUs (N22) and present ICDUs (N20) resolved into CSM control axes. (N22 -N20.)
*63	Sel mode 3 (disp tot astronaut att err)		Mode 3. Display difference between astronaut total attitude (N17) and present ICDUs (N20) resolved into CSM control axes. (N17 -N20.)
64	Req opt angle transform (R64)		V64E calls R64.
*65	Strt opt verif of prelaunch align - P03		V65E calls for P03 (during P02 only).
*66	Set CSM state vctr into Soyuz state vctr		
67	Strt W matrix RSS err disp		
*69	Restrt		

*Callable with another extended verb in use & does not lock out other extended verbs.

STA/T STEP	PROCEDURE	PANEL	REMARKS
70	Strt CMC update - liftoff time (P27)		V70 through V73 are allowed only during P00, P02 or options 1, 2 and 5 of P20 (running alone).
71	Strt CMC update - block ADR (P27)		
72	Strt CMC update - single ADR (P27)		
73	Strt CMC update - CMC time (P27)		
*74	Init erasable dump via downlink		
*75	Backup liftoff		
76	Enable R27 in R22		
*77	Disable R27 in R22		Selected only during P02.
*78	Update prelaunch az		
*80	Enbl Soyuz state vctr update		
*81	Enbl CSM state vctr update		
82	Req orb param disp (R30)		V82E calls R30.
83	Req rndz param disp #1 (R31)		V83E calls R31 (MINKEY controller initiates V83 for P37 call).
85	Req rndz param disp #2 (R34)		V85E calls R34.
*86	Reject rndz backup sighting mrk		
*87	Set VHF range flag		
*88	Rset VHF range flag		
89	Strt rndz fnl att routine (R63)		V89E calls R63 from P00 only.
90	Req rndz out of plane disp (R36)		V90E calls R36.
91	Banksum		P00 only.
*93	Enbl W matrix init		
*96	Term integration & go to P00.		
97	SPS thrust fail (R40)		
99	Enbl eng ign		

*Callable with another extended verb in use & does not lock out other extended verbs.

VERB LIST

STA/T STEP	PROCEDURE		PANEL	REMARKS
6.3	NOUN LIST			All nouns may be loaded via DSKY entry. However, registers containing units of XXBXX cannot be loaded and nouns containing such register data cannot be loaded by V24 or V25.
01	Specify address (fract)		.XXXXX .XXXXX .XXXXX	
02	Specify address (whole)		XXXXX. XXXXX. XXXXX.	
03	Specify address (deg)		XXX.XX XXX.XX XXX.XX	
04	Att error		XXX.XX DEG XXX.XX DEG XXX.XX DEG	This is a no load noun (OPR ERR).
+05	Sighting angle diff		XXX.XX DEG	
	Sighting angle		XXX.XX DEG	
+06	Option code ID		OCT	
	Option code		OCT	
+07	Flagword	ECADR	OCT	ECADR $\leq$30 (octal) will select appropriate channel (except that channel 7 attempts will be ignored).
		BIT ID	OCT	
		ACTION	OCT	
08	Alarm data	ADRES	OCT	
		BBCON	OCT	
		ERCOUNT	OCT	
09	Alarm codes	FIRST	OCT	
		SECOND	OCT	
		LAST	OCT	
10	Chan to be specified		OCT	

+Nouns not manually callable with valid data at any time.

NORMAL/BACKUP

STA/T STEP	PROCEDURE		PANEL	REMARKS
11	GETI (NCC)		OOXXX. HRS OOOXX. MIN OXX.XX SEC	
+12	Option code		OCT OCT	Used only with extended verbs.
13	GETI (NSR)		OOXXX. HRS OOOXX. MIN OXX.XX SEC	
14	OGA (star tracker)		XXXXX. ARC MIN	Star tracker azimuth.
	IGA (star tracker)		XXXXX. ARC MIN	Star tracker elevation.
15	Increment address		OCT	Used with N01, N02, and N03.
+16	Time of event		OOXXX. HRS OOOXX. MIN OXX.XX SEC	Used by extended verb only. (See N24 for limitations.)
17	Astronaut tot att	R	XXX.XX DEG	Used in Mode 3 needles (V63).
		P	XXX.XX DEG	
		Y	XXX.XX DEG	
18	Auto mnvr	R	XXX.XX DEG	
		P	XXX.XX DEG	
		Y	XXX.XX DEG	
19	OGA (star tracker)		OCT OCT	Star tracker azimuth.
20	ICDU angles	OG-R	XXX.XX DEG	Present angles.
		IG-P	XXX.XX DEG	
		MG-Y	XXX.XX DEG	
21	PIPAS	X	XXXXX. Pulses	
		Y	XXXXX. Pulses	
		Z	XXXXX. Pulses	

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE	PANEL	REMARKS
22	New ICDU angles OG-R	XXX.XX DEG	
	IG-P	XXX.XX DEG	
	MG-Y	XXX.XX DEG	
23	NB to ATM angles	XXX.XX DEG XXX.XX DEG XXX.XX DEG	Euler angles. (May apply to Soyuz coord. sys.)
+24	Δ time for CMC clock	00XXX. HRS 000XX. MIN 0XX.XX SEC	V25 N24 display initiated by V55E. (Max time = 745 hrs, 39 min, 14.55 sec.)
+25	Checklist	XXXXX.	Used with V50. (Refer to checklist codes, 6.5.)
26	Prio/delay	OCT	Used with V30, V31.
	ADRES	OCT	
	BBCON	OCT	
27	Self-test on/off sw	XXXXX.	
28	GETI (NC2)	00XXX. HRS 000XX. MIN 0XX.XX SEC	
+29	Xsm launch az	XXX.XX DEG	Xsm - X stable member.
+30	Trgt code (gyro compassing verif)	XXXXX. XXXXX. XXXXX.	
31	Time of RNDZ W-matrix last r/v initialization	00XXX. HRS 000XX. MIN 0XX.XX SEC	
32	TF perigee	00XXX. HRS 000XX. MIN 0XX.XX SEC	Time from perigee. (See N24 for limitations.)
33	GETI	00XXX. HRS 000XX. MIN 0XX.XX SEC	GETI - ground elapsed time of ignition. (See N24 for limitations.)

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE	PANEL	REMARKS
+34	Time of evnt	00XXX. HRS 000XX. MIN 0XX.XX SEC	GET. (See N24 for limitations.)
35	Time from evnt	00XXX. HRS 000XX. MIN 0XX.XX SEC	GET. (See N24 for limitations.)
36	Time of CMC clock	00XXX. HRS 000XX. MIN 0XX.XX SEC	See N24 for limitations.
37	GETI (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC	See N24 for limitations.
38	Time of state vctr	00XXX. HRS 000XX. MIN 0XX.XX SEC	
39	GETI (last mnvr)	00XXX. HRS 000XX. MIN 0XX.XX SEC	Time of last maneuver (P38). (See N24 for limitations.)
40	TF GETI/TFC	XXBXX MIN-SEC	This is a no load noun (OPR ERR).
	VG	XXXX.X FPS	Velocity to be gained (counts down).
	ΔV (accum)	XXXX.X FPS	Velocity gained this burn.
+41	Trgt Az	XXX.XX DEG	N41 - 2 component noun.
	Elev	XX.XXX DEG	
42	Ha	XXXX.X NM	Apogee altitude.
	Hp	XXXX.X NM	Perigee altitude.
	ΔV (req)	XXXX.X FPS	
43	Lat (+N)	XXX.XX DEG	
	Long (+E)	XXX.XX DEG	
	Alt	XXXX.X NM	

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE	PANEL	REMARKS
44	Ha	XXXX.X NM	Apogee altitude. This is a no load noun (OPR ERR).
	Hp	XXXX.X NM	Perigee altitude.
	TFF	XXBXX MIN-SEC	Time of freefall to 49.4 NM (300,000 ft) above launch pad radius.
45	Mrks (VHF/opt)	XXBXX MKS	This is a no load noun (OPR ERR).
	TF GETI (next burn)	XXBXX MIN-SEC	
	MGA	XXX.XX DEG	
46	DAP config (R03)	OCT	Undocked DAP.
		OCT	
47	CSM wt	XXXXX. LB	Undocked DAP
	LM wt	XXXXX. LB	Undocked DAP. LM wt not normally used for ASTP.
48	Pitch trim	XXX.XX DEG	Loads gimbal pitch and yaw trim angles.
	Yaw trim	XXX.XX DEG	
49	ΔR	XXX.XX NM	
	ΔV	XXXX.X FPS	
	Code (VHF/opt)	0000X.	
50	Splash err	XXXX.X NM	Negative for undershoot, positive for overshoot. This is a no load noun (OPR ERR).
	Hp	XXXX.X NM	
	TFF	XXBXX MIN-SEC	Time of freefall.
52	CENTANG (CSM)	XXX.XX DEG	Central angle of CSM.
53	R	XXX.XX NM	Range calculated from state vector.
	R dot	XXXX.X FPS	Range rate calculated from state vector.
	Phi (lcl horiz/SLOS)	XXX.XX DEG	0 to 180° = SLOS above plane.
54	R	XXX.XX NM	Range calculated from state vector.
	R dot	XXXX.X FPS	Range rate calculated from state vector.
	θ (lcl horiz/CSM +X)	XXX.XX DEG	0 to 180° = +X above plane.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
55	NN	0000X.	Display definition depends on using program/routine.
	E	XXX.XX DEG	Elevation.
56	Veh rate	X.XXXX DEG/SEC	This is a no load noun (OPR ERR).
		X.XXXX DEG/SEC	
		X.XXXX DEG/SEC	
57	1/2 revs	XXXXX.	
	ΔH (NCC)	XXXX.X NM	
	ΔH (NSR)	XXXX.X NM	
58	ΔV (TPI)	XXXX.X FPS	
	ΔV (TPF)	XXXX.X FPS	
	ΔT (TPI -TPI nom)	XXBXX MIN-SEC	
59	ΔVX (LOS)	XXXX.X FPS	
	ΔVY (LOS)	XXXX.X FPS	
	ΔVZ (LOS)	XXXX.X FPS	
60	G max	XXX.XX G	
	V pred	XXXXX. FPS	
	Gamma EI [lcl horiz/VI (+up)]	XXX.XX DEG	
61	Impact Lat (+N)	XXX.XX DEG	
	Impact Long (+E)	XXX.XX DEG	
	Hds up/down (+Hds up)	+/-00001.	
62	VI	XXXXX. FPS	Inertial velocity.
	H dot	XXXXX. FPS	Altitude rate.
	H pad	XXXX.X NM	Altitude above pad radius.
63	RTOGO (.05 G to splash)	XXXX.X NM	One shot display, should always be positive. .05 G represents pad loaded altitude. This is a no load noun (OPR ERR).
	VIO (at .05 G)	XXXXX. FPS	Predicted inertial velocity.
	TFE (time from .05 G)	XXBXX MIN-SEC	

NOUN LIST

STA/T STEP	PROCEDURE	PANEL	REMARKS
64	Drag accel	XXX.XX G	
	VI	XXXXX. FPS	Inertial velocity.
	Range to splash	XXXX.X NM	Negative and counting down when approaching target; positive and counting up when leaving target.
65	Sampled CMC time	00XXX. HRS 000XX. MIN 0XX.XX SEC	Fetched in interrupt.
66	Beta	XXX.XX DEG	Commanded bank angle.
	CRSRNG ERR	XXXX.X NM	Positive to right of plane (LATANG +South); negative to left of plane (-North).
	DNRNG ERR	XXXX.X NM	Negative for undershoot (PREDANGLE -θ); positive for overshoot.
67	Range to splash	XXXX.X NM	Negative counting down for approaching target; positive counting up for leaving target.
	Lat [Present pos (+N)]	XXX.XX DEG	
	Long [Present pos (+E)]	XXX.XX DEG	
68	Beta	XXX.XX DEG	Commanded bank angle.
	VI	XXXXX. FPS	Inertial velocity.
	H dot	XXXXX. FPS	Altitude rate.
69	Beta	XXX.XX DEG	Beta - commanded bank angle.
	DL	XXX.XX G	DL - drag acceleration at end of up-control.
	VL	XXXXX. FPS	VL - velocity at end of up-control.
70	Trgt code (before mrk)	OCT	Sensor/star code.
71	Trgt code (after mrk)	OCT	Sensor/star code.

STA/T STEP	PROCEDURE	PANEL	REMARKS
72	Time of R27 optim	00XXX. HRS 000XX. MIN 0XX.XX SEC	Time of R27 optimization.
73	Alt/10	XXXXX. NM	On call in P21.
	VI	XXXXX. FPS	
	Gamma	XXX.XX DEG	
74	Beta	XXX.XX DEG	
	VI	XXXXX. FPS	
	Drag accel	XXX.XX G	
75	Δ alt (NSR)	XXXX.X NM	
	ΔT (TPI -NSR)	XXBXX MIN-SEC	
	ΔT (TPI -nom TPI)	XXBXX MIN-SEC	
76	VHF R	XXX.XX NM	Current R27 values (R22, P25, P48).
	VHF R dot	XXXX.X FPS	
	Time from R27 optim	XXBXX MIN-SEC	
77	VHF R	XXX.XX NM	Optimized R27 values (R22, P25, P48).
	VHF R dot	XXXX.X FPS	
	θ/ϕ	XXX.XX DEG	R27 θ/ϕ. (ϕ in R22, θ in P48).
78	Y (gamma)	XXX.XX DEG	P20 yaw angle.
	P (rho)	XXX.XX DEG	P20 pitch angle.
	Az	XXX.XX DEG	P20 azimuth contraint.
79	Rate	X.XXXX DEG/SEC	P20 (option 2) rotation rate.
	DBD	XXX.XX DEG	P20 maneuver deadband.
80	TF GETI/TFC	XXBXX MIN-SEC	
	VG	XXXXX. FPS	
	ΔV (accum)	XXXXX. FPS	
81	ΔVX (lcl vert)	XXXX.X FPS	(ΔV components).
	ΔVY (lcl vert)	XXXX.X FPS	
	ΔVZ (lcl vert)	XXXX.X FPS	

NOUN LIST

STA/T STEP	PROCEDURE		PANEL	REMARKS
82	VGX (NSR)		XXXX.X FPS	
	VGY (NSR)		XXXX.X FPS	
	VGZ (NSR)		XXXX.X FPS	
83	ΔVX (cont)		XXXX.X FPS	(ΔV components) control = CSM control axes.
	ΔVY (cont)		XXXX.X FPS	
	ΔVZ (cont)		XXXX.X FPS	
84	VG (next mnvr)		XXXX.X FPS	
	ΔH (next mnvr)		XXXX.X NM	
	VG (3rd mnvr)		XXXX.X FPS	
85	VGX (cont)		XXXX.X FPS	(VG vector components) control = CSM control axes.
	VGY (cont)		XXXX.X FPS	
	VGZ (cont)		XXXX.X FPS	
86	ΔVX (lcl vert)		XXXXX. FPS	
	ΔVY (lcl vert)		XXXXX. FPS	
	ΔVZ (lcl vert)		XXXXX. FPS	
87	DAP config (R04)		OCT	Docked DAP.
			OCT	
			OCT	
88	Planet	X	.XXXXX	
		Y	.XXXXX	
		Z	.XXXXX	
89	DAP rate		X.XXXX DEG/SEC	Docked DAP.
	DAP DBD		XXX.XX DEG	
90	Rndz out of plane param	Y CSM)	XXX.XX NM	Active vehicle.
		Y DOT(CSM)	XXXX.X FPS	Active vehicle.
		Y DOT(Soyuz)	XXXX.X FPS	Passive vehicle.
91	Present OCDU angles	Shft	XXX.XX DEG	
		Trun	XX.XXX DEG	
92	New OCDU angles	Shft	XXX.XX DEG	
		Trun	XX.XXX DEG	

STA/T STEP	PROCEDURE	PANEL	REMARKS
93 Δ gyro angles	X Gyro	XX.XXX DEG	
	Y Gyro	XX.XXX DEG	
	Z Gyro	XX.XXX DEG	
94 Alternate LOS	Shft	XXX.XX DEG	
	Trun	XX.XXX DEG	
95 GETI (NC1)		00XXX. HRS	
		000XX. MIN	
		0XX.XX SEC	
96 Rndz out of plane param	Y (CSM)	XXX.XX NM	
	Y Dot(CSM)	XXXX.X FPS	
	Y Dot(Soyuz)	XXXX.X FPS	
+97 Sys test inputs		XXXXX.	
		XXXXX.	
		XXXXX.	
+98 Sys test results and inputs		XXXXX.	
		.XXXXX	
		XXXXX.	
99 POS ERR		XXXXX. FT	RSS value of position error.
VEL ERR		XXXX.X FPS	RSS value of velocity error.
Option code		0000X	Option code (initially 00000). 00000 - No initialization 00001 - RNDZ (W-matrix initialization)

+Nouns not manually callable with valid data at any time.

NOUN LIST

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.4 STAR LIST		**Vis Mag, Right Ascension and Declination data are in sequence with the numerical list.**

NO.	STAR NAME (Numerical)		STAR NAME (Alphabetical)	NO.
1	Alpheratz	(α And)	Acamar	6
2	Diphda	(β Cet)	Achernar	4
3	Navi	(γ Cas)	Acrux	25
4	Achernar	(α Eri)	Aldebaran	11
5	Polaris	(α UMi)	Alkaid	27
6	Acamar	(θ Eri)	Alphard	21
7	Menkar	(α Cet)	Alphecca	32
10	Mirfak	(α Per)	Alpheratz	1
11	Aldebaran	(α Tau)	Altair	40
12	Rigel	(β Ori)	Antares	33
13	Capella	(α Aur)	Arcturus	31
14	Canopus	(α Car)	Atria	34
15	Sirius	(α CMa)	Canopus	14
16	Procyon	(α CMi)	Capella	13
17	Regor	(γ^2 Vel)	Dabih	41
20	Dnoces	(ι UMa)	Deneb	43
21	Alphard	(α Hya)	Denebola	23
22	Regulus	(α Leo)	Diphda	2
23	Denebola	(β Leo)	Dnoces	20
24	Gienah	(γ Crv)	Enif	44
25	Acrux	(α^1 Cru)	Fomalhaut	45
26	Spica	(α Vir)	Gienah	24
27	Alkaid	(η UMa)	Menkar	7

Vis Mag	Right Ascension (hr)	(min)	(sec)	Declination (deg)	(min)	(sec)
2.1	0	05	48.1	+28	48	48.5
2.2	0	41	05.2	-18	15	37.9
2.8	0	53	40.4	+60	26	47.4
0.6	1	35	51.6	-57	29	25.6
2.1	1	48	52.9	+89	01	43.6
3.4	2	56	21.8	-40	30	14.6
2.8	2	59	39.7	+03	53	39.4
1.9	3	20	44.5	+49	41	05.6
1.0	4	33	03.0	+16	24	33.2
0.3	5	12	08.0	-08	15	28.7
0.2	5	12	59.6	+45	56	48.3
-0.8	6	22	50.6	-52	40	02.9
-1.5	6	42	55.6	-16	39	15.7
0.4	7	36	40.1	+05	20	53.0
1.9	8	07	59.5	-47	11	18.2
3.1	8	55	46.6	+48	14	16.6
2.1	9	25	7.8	-08	26	26.8
1.3	10	05	42.3	+12	12	44.6
2.2	11	46	29.8	+14	51	03.1
2.7	12	13	13.6	-17	15	51.4
1.5	12	23	48.0	-62	49	19.8
1.2	13	22	33.2	-10	54	04.1
1.9	13	45	34.0	+49	33	43.8

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS

NO.	STAR NAME (Numerical)		STAR NAME (Alphabetical)	NO.	Vis Mag	Right Ascension (hr)	(min)	(sec)	Declination (deg)	(min)	(sec)
30	Menkent	(θ Cen)	Menkent	30	2.2	14	03	42.9	-36	07	41.7
31	Arcturus	(α Boo)	Mirfak	10	0.2	14	13	21.0	+19	25	45.0
32	Alphecca	(α CrB)	Navi	3	2.3	15	32	34.4	+26	52	52.7
33	Antares	(α Sco)	Nunki	37	1.2	16	26	20.2	-26	19	22.5
34	Atria	(α TrA)	Peacock	42	1.8	16	43	21.2	-68	56	20.7
35	Rasalhague	(α Oph)	Polaris	5	2.1	17	32	36.9	+12	35	36.7
36	Vega	(α Lyr)	Procyon	16	0.1	18	35	15.0	+38	44	16.2
37	Nunki	(σ Sgr)	Rasalhague	35	2.1	18	52	10.0	-26	21	39.5
40	Altair	(α Aql)	Regor	17	0.8	19	48	21.4	+08	44	14.6
41	Dabih	(β Cap)	Regulus	22	3.2	20	18	12.3	-14	56	26.5
42	Peacock	(α Pav)	Rigel	12	2.1	20	21	42.3	-56	53	52.0
43	Deneb	(α Cyg)	Sirius	15	1.3	20	39	43.5	+45	06	03.2
44	Enif	(ε Peg)	Spica	26	2.5	21	41	43.8	+09	38	41.8
45	Fomalhaut	(α PsA)	Vega	36	1.2	22	54	54.1	-29	53	19.5

STAR LIST

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.5 CHECKLIST REFERENCE CODES (V50 N25)		
	R1 Code ACTION FUNCTION		
	00013 Perform Coarse align or pulse torque		
	00014 Perform Fine align option		
	00015 Perform Trgt acq		Target (celestial body) acquisition - Used in conjunction with N70, N71 and the following celestial body codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth
	00016 Key in Term mrk seq 00017 Perform MINKEY Rndz (displayed if REFSMFLG = 1)		Initiated when targeting programs P31 through P38 called by V37.
	00020 Perform MINKEY NPC torquing 00041 Sw CM/SM sep to up 00062 Key in CMC pwr down		Occurs in P52 during MINKEY plane change sequence.
	00204 Perform Enbl gmbl trim option		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.6 OPTION CODES (V04 N06 or V04 N12)		
	R1 Code / Purpose / Input for R2		
	00001 Specify IMU orientation: 1 = PREF, 2 = NOM, 3 = REFSMMAT		Specified option codes will be displayed in R1 in conjunction with V04 N06 or V04 N12. Requests desired option be loaded into R2.
	00002 Specify veh: 1 = CSM, 2 = Soyuz		
	00004 Specify state of tracking (FULTKFLG): 0 = Full track, 1 = Partial track		P20, VHF and optics marks. P20, VHF or optics marks.
	00012 Specify P50 option: 1 = Sun sensor, 2 = Sun sensor & star tracker, 3 = Angles from independent source		
	00013 Specify P55 option: 1 = Celestial body & IMU orient, 2 = Celestial body, opt mark & Soyuz solar inertial att		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	R1 Code: 00024 — Purpose: Specify tracking option — Input for R2: 0 = Rndz (VECPOINT); 1 = Celestial body (VECPOINT); 2 = Rotation; 4 = Rndz (3-axis); 5 = Celestial body (3-axis)	P20.	

6.6 OPTION CODES (V04 N06 OR V04 N12)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.7 ALARM CODES (V05 N09)		Alarms for V05 N09 (ERR RSET zeros R1 and R2; leaves R3 alone) R1 - first alarm to occur R2 - second alarm to occur R3 - last alarm to occur (There is no indication as to whether 3 or more than 3, alarms have occurred)
	Codes are listed numerically by the four least significant digits. Codes beginning with 2 or 3 signifiy the following:		The following list shows general numbering logic for alarm codes excluding interface and exceptions: 00100-00200 Optics subsystem 00200-00300 IMU subsystem 00400-00600 Rendezvous 01100-01200 Computer hardware malfunctions 01200-01300 List overflows (all aborts) 01300-01400 Interpreter errors 01400-01500 Display alarms 01500-01600 Keyboard and display programs 01600-01700 System test alarms 01700-01800 DAP display alarms
	Codes starting with 2 signifies POODOO routine: generates software restart (if ave G running or display type extended verb active, same as BAILOUT; if not, goes to ROO). Will not turn on RESTART lt		
	Codes starting with 3 signifies BAILOUT routine: generates software restart (returns to interrupted program). Does not turn on RESTART lt		
	00107 Star tracker angles out of limits		P55.
	00110 Mrk reject has been entered but ignored (continue)		Either no marks have been received or there have been no marks since last mark reject.
	00113 No chan 16 inbits (continue)		If alarm recurs, use MDC DSKY.

STA/T STEP	PROCEDURE	PANEL	REMARKS
00114	More mrks made than desired (continue)		
00115	V41 N91 keyed with OPT MODE not in CMC		Set OPT MODE - CMC and OPT ZERO - OFF. OPR ERR also lights.
			Set OPT ZERO - ZERO (≈15 sec to zero).
00116	Opt sw altered before 15 sec zero time elapsed		
00117	V41 N91 keyed but CMC has reserved OCDU		V41 N91 not yet available. May occur from start of drive test until end of burn. (not expected since V41 N91 is restricted to P00).
			Set OPT ZERO - OFF then ZERO (≈15 sec to zero).
00120	Opt torque has been req but opt have not been zeroed since last FRESH START or RESTART		
00121	SC att rates of ≥ two-thirds deg per sec will result in auto reject of sighting mrks		Repeat mark.
00205	PIPA saturated		Use SCS control. Refer to G&N malfunction procedures, symptom 12. While thrusting navigation (average G) is operating, a PIPA output in excess of 6399 pulses in a 2-second period has been detected.
00206	IMU zero routine has been entered with both GMBL LOCK lt and NO ATT lt on		Coarse align to 0, 0, 0. Reselect V40E. IMU mode switching.
00207	ISS turn-on req not present for 90 sec		Redo IMU turn on. Refer to G&N malfunction procedures, symptom 12.
00210	ISS not on		Redo IMU turn on. If alarm recurs, perform fresh start (V36E). Consult STDN. Refer to malfunction procedures, symptom 12. Used by IMU zero routine, R02, P51, and P53.

STA/T STEP	PROCEDURE	PANEL	REMARKS
00211	Coarse align err		If P51, 53/P52, 54 in progress, record gyro torquing angles and perform fine align check in P52, 54. Otherwise, refer to V41 N20. Refer to G&N malfunction procedures, symptom 12. Following coarse align, an ICDU is found not to be within 2° of its desired value.
00212	PIPA fail, but PIPA not being used		PIPA BIAS check. Refer to G&N malfunction procedures, symptom 6, step 7. A PIPA fail signal has been received by CMC but PIPAs are not being used (average G not on); or CMC has just finished with PIPAs and finds a PIPA fail signal. For latter case, ISS warning light is extinguished.
00213	IMU not operating with turn-on req		Refer to 00210. CMC has detected an ISS turn-on request but finds ISS operate not present.
00214	Prog using IMU when turned off		Refer to 00210 or exit program. IMU not in use (IMUSE flag reset). IMU in use (IMUSE flag set).
00217	IMU coarse align or pulse torque difficulty has occurred		If 00211 concurrent with 00217, proceed per 00211 recovery. If not, reinitiate current program. If alarm recurs, terminate use of ISS. Refer to G&N malfunction procedures, symptom 12. This alarm is issued in alignment program, P5X, if coarse align or gyro torquing attempted during IMU turn-on, while a cage command is present or while IMU zeroing is taking place. It is also issued if coarse align failure has occurred (code 211) or if CMC detects ISS warning light on at end of a "successful" coarse alignment or gyro torquing process.

STA/T STEP	PROCEDURE	PANEL	REMARKS
00220	IMU orient unknown		R02. Align or if aligned, set REFSMFLG.
00401	Desired middle gmbl angle excessive		If MGA >75°, CMC establishes attitude hold. Call N22 - maneuver, or realign IMU. Alarm will be generated if MGA >60° is calculated during: a. Realignment in P52/54 b. Entry attitude in P62 and P64 (if velocity is <27K FPS at .05 G point). c. P20 (options 4 or 5).
00402	Honor second MINKEY torque request		P52 - During MINKEY plane change, if first gyro torquing done, second torquing must be done.
00404	Trgt out of view (90 deg test)		P52. A trunnion angle >90° required to acquire star. This is a priority alarm and will be displayed by CMC with a flashing V05 N09.
00405	Acpt star pair not avail		In P52 and P54, CMC searches for pair of nav stars which are not <30° and not >76° apart. In addition, neither star may be occulted by earth, sun or moon, and each star must be within 38° of optics shaft axis. If no such pair can be found, alarm is displayed automatically by computer with a flashing V05 N09.
00406	Rndz nav not oper		V54 has been entered but rendezvous tracking is not operating. CMC ignores request for marks and reinstates interrupted display, if any. Select P20 (option 0 or 4), or continue.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
00421	W-matrix overflow		Notify STDN but continue. W-matrix automatically reinitialized at next mark.
20430	Orb integration		Notify STDN. Probable state vector uplink required. This may happen if CMC attempts to integrate a state vector that intersects earth. A state vector update may be required.
00500	Not enough jets for some pitch or yaw rotation		Docked DAP.
00501	Not enough jets for some roll rotation		Docked DAP.
00600	Failure in phase match iterations		
00601	Failure in either NC2 or NCC height mnvr iterations		
00602	Failure in outer (phase) loop iterations		
00603	Failure in QRDTPI iterations		
20607	No solution from time θ or time radius		Reselect program. Vehicle will be in a hyperbolic orbit, or entry angle too steep.
00611	No TIG for given ELEV angle		P34, P35.
00777	ISS warning caused by PIPA fail		Refer to G&N malfunction procedures, symptom 6.
01102	CMC self test err		Self check.
31104	Delay routine busy		Reselect extended verb or continue with program. Notify STDN. An internal routine (DELAYJOB) used by CMC to cause variable time delays, has received requests from more than 4 jobs.
01105	Downlink too fast		Rset. If alarm recurs, DOWNLINK FAILURE. Refer to G&N malfunction procedures, symptom 12.
01106	Uplink too fast		Rset. If alarm recurs, UPLINK FAILURE. Refer to G&N malfunction procedures, symptom 12.

ALARM CODES (V05 N09)

STA/T STEP	PROCEDURE	PANEL	REMARKS
01107	Phase table failure - assume erasable memory is destroyed		Perform: 1. V74 CMC DOWNLINK 2. P27 as necessary 3. V48 or V44 as necessary (V46/V45) 4. Re-establish REFSMMAT via P51 as necessary. If FRESH START recurs, CMC FAILURE. Refer to malfunction procedures, symptom SSR-3. During CMC restart, a phase table disagreement was found. CMC will perform an automatic fresh start if this condition exists.
31201	Exec overflow - no VAC area		Reselect extended verb and/or continue program.
31202	Exec overflow - no core sets		Refer to 31201.
31203	Waitlist overflow - too many tasks		Refer to 31201.
21204	Neg or zero waitlist call		If average G on or display type extended verb active, continue. Otherwise reselect program.
21206	Second job attempts to go to sleep via keyboard and disp prog		Refer to 21204.
21210	Second attempt is made to stall		Reselect program. Do not attempt use of device while CMC is using it. While performing certain IMU mode switching functions CMC begins a function and then "stalls" until appropriate job has been completed. If a second attempt is made to stall for the same reason (i.e., IMU mode switch), this alarm is generated.

STA/T STEP	PROCEDURE	PANEL	REMARKS
31211	Illegal interrupt of extended verb		Reselect extended verb after optics marking completed. If an internal request for marks (SXTMARK) made, CMC tests to see if mark system already busy or if an extended verb active. If either condition is discovered, alarm is generated.
01301	Arcsin or arccos input >1		Notify STDN, continue.
21302	SQRT called with neg argument		Refer to 21204.
01407	VG incr		P40. Refer to G&N malfunction procedures, symptom 12. CMC has determined that last measured value of ΔV was in such a direction as to cause VG to increase rather than decrease. As long as this condition exists, value of time to go to cutoff is not recalculated (although R1 of N40 will continue to count down) and an automatic engine-off command will not be sent by CMC.
01426	IMU unsatisfactory		Realign or use SCS. Neither +Y stable member axis nor -Y stable member axis within 30° of $\underline{V} \times \underline{R}$ where $\underline{V}$ and $\underline{R}$ are present vehicle velocity and position vectors respectively. The test for this condition performed at beginning of P61 and P62.
01427	IMU reversed		Note FDAI operation is inverted. The -Y stable member axis is within 30° of $\underline{V} \times \underline{R}$ (cf. code 1426).
21501	Keyboard and disp alarm during internal use (NVSUB).		Refer to 21204.
21502	Illegal flashing disp		Refer to 21204.

STA/T STEP	PROCEDURE	PANEL	REMARKS
01520	V37 req not permitted at this time		Wait until COMP ACTY light not on continuously, reselect V37 or if P62/P67, select P00 and then desired program. Alarm will be generated if a V37 request made with IMU as follows: a. In its 90-second turn-on period b. Being caged c. Being zeroed. It will also be generated if V37 request is made for a program other than P00 after entry DAP has been started in P62, during P77, P00 integration (including P20 options 1, 2, 5 periodic integration), and P06.
21521	P01 illegally sel		Refer to 21204.
01600	Overflow in drift test		This is ground test alarm only.
01601	Bad IMU torque abort		Refer to 01600. Generated in P01, P02, or P07.
01703	Insufficient time for integration		P40, P41. Will occur between TIG -42.5 and TIG -35 seconds.
32000	DAP JASK still in process when next JASK attempted		Docked DAP.
03777	ISS warning caused by ICDU fail		Refer to G&N malfunction procedures, symptom 6.
04777	ISS warning caused by ICDU and PIPA fail		Refer to G&N malfunction procedures, symptom 6.
07777	ISS warning caused by IMU fail		Refer to G&N malfunction procedures, symptom 6.
10777	ISS warning caused by IMU and PIPA fail		Refer to G&N malfunction procedures, symptom 6.
13777	ISS warning caused by IMU and ICDU fail		Refer to G&N malfunction procedures, symptom 6.
14777	ISS warning caused by IMU, ICDU, and PIPA fail		Refer to G&N malfunction procedures, symptom 6.

STA/T STEP	PROCEDURE	PANEL	REMARKS

6.8 CMC PROGRAM - ROUTINE INDEX

6.8.1 Programs

Phase	Program No.	Program Title	Contains Crew Interface Routines
Pre-Launch & Service	00	CMC idling	R00
	01	Prelaunch or service init	None
	02	Prelaunch or service gyro compassing	None
	03	Prelaunch or service opt verif of gyro compassing	None
	06	CMC pwr down	R00
	07	System test	
Boost	11	Earth orb insertion monitor	R00
Coast	20	Universal track & rndz nav	R00,R02,R07, R21,R22, R23,R27, R52,R60, R61,R67
	21	Grd track determ	R00
	25	Contingency R dot	R00,R27
	27	CMC update	None
	29	Time of Longitude	R00

Do not select the following program sequences:

a. P40/P41 - P27 - P52
(P27 overwrites preferred attitude computations) Redo P40/P41 up to V50 N18, then reselect P52

b. P27 - P40/P41 - P52
Reload preferred REFSMMAT from ground.

STA/T STEP		PROCEDURE	PANEL	REMARKS
Phase	Program No.	Program Title	Contains Crew Interface Routines	
Pre-Thrusting	30	External ΔV	R00	
	31	LOI targeting	R00,R07	
	32	LOI2 targeting	R00,R07	
	33	LOC targeting	R00,R07	
	34	LOR targeting	R00,R07	
	35	TPI targeting	R00,R07	
	36	TPM targeting	R00,R07	
	37	TPF targeting	R00,R07	R00 via R31.
	38	NPC targeting	R00,R07	
Thrusting	40	SPS	R02,R07,R40, R41,R60,R00	
	41	RCS	R02,R07,R41, R60,R00	
	47	Thrust mon	R02,R41,R00	
	48	RNDZ thrust mon (final phase)	R02,R07,R27, R41,R00	Called as final program in MINKEY rendezvous sequence.
Align-ment	50	Soyuz orient determ	R00,R02,R53	
	51	IMU orient determ	R02,R53,R54, R00	
	52	IMU realign	R02,R07,R50, R00,R52, R53,R54 R55	
	53	Back-up IMU orient determ	R56,R54,R00	

STA/T STEP		PROCEDURE	PANEL	REMARKS
Phase	Program No.	Program Title	Contains Crew Interface Routines	
	54	Back-up IMU realign	R02,R50,R00, R56,R54,R55	
	55	Soyuz Star Tracker Gimbal Angle Program	R02,R53,R00	
Entry	61	Entry prep	R02	
	62	CM/SM sep and pre-entry mnvr	R02	
	63	Entry init	None	
	64	Post 0.05 G	None	
	65	Entry upcontrol	None	Although P65 and P66 are included in the ASTP, they are bypassed in Earth orbit missions and, therefore, are not included in the Entry procedures, see 6-... (For Earth orbit missions, P64 automatically calls P67 as next program.)
	66	Ballistic entry	None	
	67	Final phase	R00	
Post thrusting	77	CSM velocity vector update	R00	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.8.2 Routines		
	Routine — Routine Title		
	00 Fnl auto req term		Manually selected by crew (V48E).
	01 Erasable & chan modification		Manually selected by crew (V44E).
	02 INU stat check		Initiated by selection of a rndz targeting program.
	03 Undocked DAP (UDAP) data load		
	04 Docked DAP (DDAP) data load		Selected by R22 when enabled by V87E (disabled by V88E).
	07 MINKEY controller		Selected by R22 via R27 when enabled by V76E (disabled by V77E).
	13 VHF racar read		Selected by P25 and P48 via R27.
	21 Rndz tracking sighting mrk		P20 (options 0, 4). Selected by MARK or MARK REJ.
	22 Rndz tracking data processing		P20 (options 0, 4).
	23 Backup rndz tracking sighting mrk		Manually selected by crew (V54E).
	27 VHF range/range rate filter		Selected auto by either P25 or P48. Selected by R22 via V76E (disabled by V77E or by P20 initialization).
	30 Orb param disp		May be called by crew (V82E).
	31 Rndz param disp routine No. 1		Displays range, range rate, and the angle between CSM +X axis and local horizontal (theta). Selected by crew (V83E), or automatically by MINKEY controller via P37.

STA/T STEP	PROCEDURE	PANEL	REMARKS
Routine	Routine Title		
34	Rndz param disp routine No. 2		Displays range, range rate, and angle between optics star line of sight and local horizontal (phi). Selected by crew (V85E).
36	Rndz out of plane disp		Selected by V90E.
40	SPS thrust fail		Selected by P40.
41	State vctr integration (mid to ave)		Selected by P40, P41, P47, P48.
50	Coarse align		Selected by P52, P54.
52	Auto opt positioning		Automatically selected by P20 or P52. It is self-perpetuating and terminated by R53 for star sightings.
53	Sighting mrk		Selected in R52 by OPT MODE - MAN or OPT ZERO - ZERO. Selected in P50, N06 (options 1 or 2). Selected auto in P51, P52. Selected in P55, N06 (option 2).
54	Sighting data disp		Selected auto by P51, P52, P53, P54.
55	Gyro torquing		Selected auto by P52, P54.
56	Alternate LOS sighting mrk		Used to perform sighting marks for backup alignment programs P53 and P54.
60	Att mnvr		Selected by P40, P41, R61(P20), R62(V49E), R63(V89E).
61	Tracking att		Orients CSM properly with respect to target vehicle during target tracking. Selected auto by P20 and by R52 during P20.
62	Crew defined mnvr		Selected by (V49E) via P00 only.
63	Rndz fnl att		Selected by (V89E) via P00 only.
64	Opt angle transform		Selected by (V64E).
67	Rotation mnvr		P20 (option 2).

ROUTINES

6.9 CMC PROGRAM - FLAG LISTING (Defines Location & Utilization)

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
	P29FLAG	0	00074	1	P29 running. 1st pass in progress	P29 finished with 1st pass
Rendezvous	NC12FLG	0	00074	5	P32 (NC2)	P31 (NC1)
Sighting mark	SGTMK	0	00074	6	FL V51 initiated	FL V51 not initiated
Rendezvous	RNDVZFLG	0	00074	7	P20 (option 0 or 4) initiated	P20 (option 1, 2, 5) initiated
IMU	IMUSE	0	00074	8	IMU in use	IMU not in use
Alignment	P50FLAG	0	00074	10	P50 initiated	P50 not initiated
	P50.1FLG	0	00074	12	P50 option 1 selected	P50 option 1 not selected
	P55.1FLG	0	00074	13	P55 option 1 selected	P55 option 1 not selected
Marking	MARKFLG	1	00075	4	Mark accepted, allow mark reject	Mark not accepted, do not mark reject
Track	TRACKFLG	1	00075	5	P20 tracking	P20 not tracking
Update	UPDATFLG	1	00075	7	State vector updating by marks allowed	State vector updating by marks not allowed

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
State vctr	CSMUPDAT	1	00075	8	CSM state vector to be updated by nav measurement. Can be set by V81E.	Soyuz state vector to be updated by nav measurement. Can be reset by V80E.
Trgt 1	SWSTRG	1	00075	10	Sighting Soyuz	Not sighting Soyuz.
Prelaunch	NODOP01	1	00075	12	Inhibits P01 (set 1 near start of P11)	Enables P01 (set 0 by pad load)
Stick flag	STIKFLAG	1	00075	14	RHC out of detent or |MGA| >75° (auto maneuver not enabled)	RHC in detent & |MGA| ≤75° (auto maneuver enabled)
Preferred att	PFRATFLG	2	00076	4	Preferred SC attitude computed	Preferred SC attitude not computed
Final computation	FINALFLG	2	00076	6	Final pass through rendezvous program computations	Interim pass through rendezvous program computations
External ΔV	XDELVFLG	2	00076	[illegible]	External ΔV VG computations	Lambert VG computations
	ITERFLG	2	00076	13	15 iterations have occurred	15 iterations have not occurred
Marking (P20)	R21MARK	2	00076	14	P20 (options 0 or 4) active (special mark processing & optics rather than B/U marks being processed). Set on V54 (R23) exit.	P20 (options 1, 2, 5) active

CMC PROGRAM - FLAG LISTING

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Gyro drift compensation	DRIFTFLG	2	00076	15	Drifting flight gyro compensation performed	Drifting flight gyro compensation not performed
Docked/Undocked DAPS	45/46FLG	3	00077	6	V45E	V46E
IMU orientation known (REFSMFLG)	REFSMFLG	3	00077	13	REFSMMAT good	REFSMMAT not good
Maneuvers	GLOKFAIL	3	00077	14	Gimbal lock has occurred	Not in gimbal lock
Auto maneuvers	V50N18FL	3	00077	15	Start of P20, V37E, or V58E (unless P00 selected). If Δ angle >10° in R61, R60 entered	Upon completion of R61
(No DSK listing)		4	00100			
W matrix (rndz nav)	RENDWFLG	5	00101	1	W matrix for rendezvous navigation is valid	W matrix for rendezvous navigation is invalid
Liftoff discrete	BKUPLO	5	00101	5	V75E backup of L/O discrete	Prior to L/O. Remains reset if no V75E
3 axis	3AXISFLG	5	00101	6	Maneuver specified by 3-axes: P20 (option 4, 5), V49	Maneuver specified by VECPOINT P20 (option 0, 1), P40/P41, V89
Rendezvous	ITSWICH	7	00103	14	Solution for TPI time not reached	Solution for TPI time reached
Terminate	TERMIFLG	7	00103	15	Terminate R52 and R53	Do not terminate

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Tracking (P20)	R67FLAG	8	00104	2	R67 (P20 option 2) rotation active	R67 rotation not active
P00 integration	V96ONFLG	8	00104	3	P00 integration inhibited. Set by V96E	Integration proceeding normally (P00 selected)
Tracking (P20)	UTFLAG	8	00104	9	P20 (options 1, 2, 5) selected	P20 (options 0, 4) selected, or by P00, V56E, P06, P00D00 or IMU turn off
Select R31/R34	R31FLAG	9	00105	4	V83E (request R31)	V85E (request R34)
Terminate periodic P00 integration	QUITFLAG	9	00105	5	V96E (stop P00 periodic state vector integration)	Reset in P00 (if found to be set) remains reset until new prog (other than P27) selected.
FDAI error (N22 or N17)	N22ERNDS	9	00105	6	V62E	V63E
Marking (R22)	R22CAFLG	9	00105	7	Optics mark being processed	Optics mark not being processed
Marking (R22)	VHFSOURC	9	00105	8	VHF radar used as input source for marks	Optics mark used as input source
VHF ranging	VHFRFLAG	9	00105	9	V87E Process VHF ranging data (periodically)	V88E (or R00) do not process VHF ranging data

CMC PROGRAM - FLAG LISTING

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Targeting (P38)	PCFLAG	10	00106	1	In P38 (P38 plane change trgting to be done)	Not P38, PRO on V50 N25 (R1 = 17), in P52 if puls. torquing done.
Marking	FULMKFLG	10	00106	2	Either optics or VHF marks to be taken (set in V57)	Both optics and VHF marks to be taken (reset in V57
Targeting (P35)	TPIMNFLG	10	00106	3	TPI targeting complete	TPI targeting not complete
	PTV93FLG	10	00106	4	V93 to be done after maneuver	Maneuver and V93 done
	MANEUFLG	10	00106	5	Indicates no mark has been processed since last final computation cycle of a targeting program (except P38). Set on PRO response to FL V50 N25 (R1 = 00017)	Mark incorporated in R22
Plane change	TCOMPFLG	10	00106	6	(- then + torque)	(+ then - torque)
MINKEY rendezvous	AUTOSEQ	10	00106	7	Automatic rendezvous (MINKEY) sequence running	Non-MINKEY rendezvous selected
Rendezvous	P35FLAG	10	00106	8	MCC targeting done	MCC targeting not done

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Ranging (P20)	EXTRANGE	10	00106	9	In R61	In R00
Tracking	HDSUPFLG	10	00106	11	Heads-up attitude	Heads-down attitude
Marking	REJCTFLG	10	00106	12	Mark to be rejected in R22 by MARK REJ or V86	No mark reject in R22 (reset in R22 after mark processing)
Maneuver (P20)	PCMANFLG	10	00106	15	P20 NPC maneuver	No P20 NPC maneuver
Rendezvous	R27UP1	11	00107	1	1st pass in R27 complete	1st pass not complete
Rendezvous	R27UP2	11	00107	2	2nd pass in R27 complete	2nd pass not complete
Rendezvous	TDFLAG	11	00107	3	TD angle in R27 computed	TD angle in R27 not computed
Ranging	P25FLAG	11	00107	4	P25 operating	P25 not operating
Thrusting	P48FLAG	11	00107	5	P48 operating	P48 not operating
Rendezvous	SNAPFLAG	11	00107	6	Inhibit R22 mrk processing	Allow R22 mrk processing
Rendezvous	FIXFLAG	11	00107	7	R27 in optimizing mode	R27 in current mode
Tracking (P20)	AZIMFLAG	11	00107	8	P20 (options 4, 5). Indicates 3-axis maneuver desired in R61	P20 (options 0, 1, 2) and by V89 before maneuver calculated

CMC PROGRAM - FLAG LISTING

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Ranging	N77FLAG	11	00107	9	N77 = optimized R dot	Allow current state in N77
Display	NOUNFLG	11	00107	10	Display N77	Display N76
Rendezvous	CYCLFLAG	11	00107	11	R27 processing mark	R27 ready for new mark
Rendezvous	R27FLAG	11	00107	12	Allow R27 in P20 (V76E)	Inhibit R27 in P20 (V77E)
NON-FLAGS						
ISS zero	IMODES30		01323	9	IMU operate bit present (set to 0)	IMU operate bit not present (reset to 1)
Att hold	HOLDFLAG		01330			

(+) Sample CDU angles before resuming attitude hold and resetting HOLDFLAG to (+0).

(+0) Remain in attitude hold at previously established reference angles. Set (this state) by DAP when |MGA| >75°

(-) Enable automatic steering.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	7.0 G&C REFERENCE MODES This section provides information about basic G&C functions by defining them in terms of system operating prerequisites and switch positions which together represent reference modes. Their scope is limited to independent system functions. These reference modes are repeatable and are applicable to all G&C procedures and thus are referenced in all subsequent sections of G&C procedures. The modes, however, are NOT intended to be complete or self-contained procedures. Wherever a step in one of these G&C reference modes references another mode, the title and paragraph number of the referenced mode is shown and the recommended options in the mode, if any, are specified. Only those switches which are required to be in unique positions are shown in the affected step after the mode is referenced. During time-critical mission phases, reference to other sections of the handbook cannot be accommodated, and, therefore, all time-critical operations are self-contained. Modes similar to those shown in this section, however, are contained or repeated within the time-critical procedures. For general G&C operating data, refer to operating notes, 6.1.		
	7.1 ATTITUDE CONTROL		
	7.1.1 SCS Channel Selection		Provides methods for enabling RCS auto coils without undesirable jet firings.
	1 Set pwr sw		
AC	LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch, THC CW switch and ATT 1/RATE 2 and RATE 2 positions of BMAG MODE switches.
	SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2 Enable auto coils		
	For CMC cont		
AC	SC cont - CMC/FREE SC CONT - CMC CMC MODE - FREE	1	For post CM/SM separation, AUTO RCS A/C ROLL switches should be OFF, and DAP configured for B/D roll. Also refer to 6.1.1, note 8.
	MAN ATT (3) - MIN IMP or RATE CMD		6.1.1, note 9.
	AUTO RCS (16) - as desired	8	
	For SCS cont		
	a. SC cont - SCS SC CONT - SCS	1	
	or SC CONT - CMC THC - CW		
	b. BMAG MODE (3) - RATE 2		BMAG MODE or MAN ATT switching prevents attitude error signals from causing jet firings.
	or MAN ATT (3) - MIN IMP or ACCEL CMD		
	c. AUTO RCS (16) - MNA or MNB	8	For SCS control, switches should be set by quad and rotation axis, as desired. Only one roll quad should be enabled for SCS control to optimize RCS fuel consumption. One exception is 3-axis translation when all quads required.

SCS CHANNEL SELECTION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.1.2 SCS Minimum Impulse		
AC	1	Set pwr sw ELEC PWR - GDC/ECA or ECA	7	Either position required for minimum impulse generator.
		LOGIC 2/3 PWR - on (up) SIG CONDR/DR BIAS PWR (both) - AC1 or AC2 RHC PWR NORM (both) - AC/DC	7 1	Supplies 28 vdc to SC CONT and THC CW switches. 6.1.2, note 5.
	2	Sel min imp cont SC cont - SCS/MIN IMP SC CONT - SCS MAN ATT - MIN IMP or SC CONT - CMC MAN ATT - MIN IMP THC - CW		Switches should be set by axis as desired.
	3	Enable auto coils, 7.1.1		
		7.1.3 SCS Acceleration Command		
	1	Set pwr sw LOGIC 2/3 PWR - on (up) SIG CONDR/DR BIAS PWR (both) - AC1 or AC2 RHC PWR NORM (both) - AC/DC	7 1	Supplies 28 vdc to SC CONT switch. 6.1.2, note 5.
	2	Sel accel cmd cont MAN ATT - ACCEL CMD		Switches should be set by axis as desired.
	3	Enable auto coils, 7.1.1		Either CMC or SCS control permissible while enabling coils.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.1.4 SCS Attitude Hold/Rate Command		
	1	Set pwr sw		
AC		LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch.
		ELEC PWR - GDC/ECA or ECA		
		SIG CONDR/DR BIAS PWR 1 - AC1 or AC2		Provides SCS signal conditioner power for RHC proportional rate command TLM. Also refer to 6.1.2, note 5.
		BMAG PWR (both) - ON		If rate damping only desired, BMAG 1 need not be turned ON but should be set to WARMUP.
		RHC PWR NORM (1, 2 or BOTH) - AC/DC	1	If manual override of attitude hold desired.
	2	Enable auto coils, 7.1.1		6.1.1, note 8.
	3	Establish att hold/rate cmd		Switches may be set by axis as desired. Also refer to 6.1.2, note 6.
		SC cont - SCS/RATE CMD		
		SC CONT - SCS		
		MAN ATT - RATE CMD		
		or SC CONT - CMC		
		MAN ATT - RATE CMD		
		THC - CW		
		SC cont - SCS/att hold		MAN ATT - RATE CMD and BMAG MODE - ATT 1/RATE 2 inclusive required to establish attitude hold.
		SC CONT - SCS		
		MAN ATT - RATE CMD		

SCS ATTITUDE HOLD/RATE COMMAND

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	or SC CONT - CMC MAN ATT - RATE CMD THC - CW	1	
	BMAG MODE - ATT 1/RATE 2		
	7.1.5 CMC Minimum Impulse		
1	The following are req CMC - on, 8.1.3 RCS DAP - load & activate, 8.2.1		CMC, ISS, and RCS DAP enable autopilot control. Minimum impulse controller (MIC), located on panel 122 in LEB, and RHC provide minimum impulse command capability in this mode. RHC will provide normal acceleration commands providing MAN ATT switches at ACCEL CMD.
	ISS - on (desired), 8.1.3		For display of ISS total attitude and errors.
2	Set pwr sw LOGIC 2/3 PWR - on (up) SIG CONDR/DR BIAS PWR (both) - AC1 or AC2 RHC PWR NORM (both) - AC/DC	7 1	Supplies 28 vdc to SC CONT switch. 6.1.2, note 5.
3	Establish CMC Cont SC cont - CMC/MIN IMP SC CONT - CMC CMC MODE - FREE MAN ATT (3) - MIN IMP		ACCEL CMD position cannot be used (inhibits CMC outputs to jets).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		or SC CONT - CMC CMC MODE - FREE MAN ATT (3) - RATE CMD BMAG MODE (3) - RATE 2	1	
		For accel cmds MAN ATT (3) - ACCEL CMD		6.1.1, note 9.
	4	Enable Auto Coils, 7.1.1		
		7.1.6 CMC Attitude Control - Auto/Hold		
	1	The following are req CMC - on, 8.1.3 ISS - on, 8.1.3 RCS DAP - load & activate, 8.2.1		CMC, ISS, and RCS DAP enable autopilot control.
	2	Set pwr sw LOGIC 2/3 PWR - on (up) SIG CONDR/DR BIAS PWR (both) - AC1 or AC2	7	Supplies 28 vdc to SC CONT switch. 6.1.2, note 5.
	3	Enable auto coils, 7.1.1		
	4	Establish att cont SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO MAN ATT - MIN IMP	1	AUTO position must be selected when CMC automatic maneuver desired.

CMC ATTITUDE CONTROL - AUTO/HOLD

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		or SC CONT - CMC CMC MODE - AUTO MAN ATT - RATE CMD	1	
		SC cont - CMC/HOLD SC CONT - CMC CMC MODE - HOLD MAN ATT - MIN IMP		
		or SC CONT - CMC CMC MODE - HOLD MAN ATT - RATE CMD		
		7.1.7 SIVB Attitude Control		Describes condition required to enable RHC rate control of SIVB.
	1	The following are req CMC - on, 8.1.3		
		LOGIC 2/3 PWR - on (up)	7	Supplies power for caging BMAGs via BMAG MODE switches.
		ISS - on (desired), 8.1.3		For display of ISS total attitude and errors.
	2	Enable att cont		
CP		Saturn DAP activated, 8.2.1	2,140	Load 3 in configuration option of DAP activation procedure. Also refer to 6.1.1, note 8. When RCS CMD - ON, AUTO RCS switches should be off to prevent SM jet firing.
		LV GUID sw - CMC	2	SIVB attitude control for boost normally provided by IU. Switch is set to CMC if SIVB takeover required.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	7.1.8 Direct RCS		Provides RCS direct coil commands when RHC deflected (≈11°) to direct switches. Direct commands inhibit SCS and CMC commands to auto coils in respective axis (or axes). RCS continues to fire as long as direct commands present. G&N and/or SCS systems may be on or off.
AC	SIG CONDR/DR BIAS PWR 1 - AC1 or AC2	7	Provides SCS signal conditioner power for RHC direct enable TLM. Also refer to 6.1.2, note 5.
1	Enable direct RCS Full authority RHC PWR DIR (1, 2 or both) - MNA/MNB		All RCS direct coils enabled.
	or RHC PWR DIR 1 - MNA RHC PWR DIR 2 - MNB		
	Maneuver RHC - deflect to hardstops		If G&N/SCS systems on, and configured to fire RCS jets, will have momentary firing of auto coils until direct switches close (in axis). Closing direct switches inhibits both + and - auto commands.
	Half authority		Configures direct RCS for half authority, which prevents more than two SM RCS roll thrusters and more than one pitch and yaw thruster from firing in any one direction. If consideration essential, also provides method of minimizing RCS propellant consumption in direct RCS mode.

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	cb SCS CONTR DIR 1 MNB (MNA) - open cb SCS CONTR DIR 2 MNA (MNB) - open	8	Enables following direct thrusters:
	RHC PWR DIR (both) - MNA/MNB	1	

AXIS	cb's open: DIR 1 MNB, DIR 2 MNA — Jets enabled	cb's open: DIR 1 MNA, DIR 2 MNB — Jets enabled
+P	C3	A3
-P	A4	C4
+Y	B3	D3
-Y	D4	B4
+R	C1, A1	D1, B1
-R	C2, A2	D2, B2

Maneuver
RHC - deflect to hardstops

2 To terminate direct RCS
RHC - neutral

3 To inhibit direct RCS
RHC PWR DIR (1, 2 or both) - OFF

7.2 DYNAMIC DISPLAY MONITOR

7.2.1 Rate Display

Provides methods for displaying rate information on rate needles of FDAI 1 or FDAI 2, or both, as desired.

1 Set pwr sw
FDAI/GPI PWR - 1, 2 or BOTH — 7

Provides power for display electronics. Position chosen depends on which FDAI(s) desired.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LOGIC 2/3 PWR - on (up)	7	6.1.1, note 7.
		BMAG 2 PWR - ON (req if BMAG 2 desired) BMAG 1 PWR - ON (req if BMAG 1 desired)		Either BMAG 1 or BMAG 2 may be selected to provide information. BMAG 2 normally used and BMAG 1 provides backup capability.
	2	Sel desired rate source BMAG MODE - RATE 2 or ATT 1/RATE 2	1	Switches should be set by axis as desired. Selects BMAG 2.
	or	BMAG MODE - RATE 1		Selects BMAG 1.
	3	Sel disp configuration FDAI SEL - 1		Displays rate from BMAG 1 or 2 on FDAI 1 only.
	or	FDAI SEL - 2		Displays rate from BMAG 1 or 2 on FDAI 2 only.
	or	FDAI SEL - 1/2		Displays rate from BMAG 1 or 2 on both FDAIs.
	7.2.2	Attitude Error Display - BMAG Source		Provides methods for displaying BMAG 1 attitude error information on FDAI 1 or FDAI 2. Needles display attitude excursion from point at which BMAGs are uncaged up to a maximum of 17°.
	1	Set pwr sw FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position chosen depends on which FDAI(s) desired.

ATTITUDE ERROR DISPLAY - BMAG SOURCE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LOGIC 2/3 PWR - on (up)	7	Supplies power for caging BMAGs via BMAG MODE switches.
		BMAG 1 PWR - ON		Powers BMAGs in gyro assembly 1, the only BMAGs capable of providing attitude error information.
	2	Provide att err info MAN ATT - RATE CMD	1	Switches should be set by axis as desired. RATE CMD position required to uncage BMAG 1. However, RHC breakout and MAN ATT switches overridden by IGN 2 logic signal during thrusting to uncage BMAGs.
		BMAG MODE - ATT 1/RATE 2 .05 G sw - OFF (verify)		On (up) position not desirable (cages BMAGs).
		RHC - neutral		If RHC breakout switches activated, BMAGs caged (by axis) and attitude hold lost.
	3	Sel disp configuration		
		a. FDAI SEL - 1/2		Displays attitude error from BMAG 1 on FDAI 2.
or		b. FDAI SEL - 1 or 2 FDAI SOURCE - GDC		Displays attitude error from BMAG 1 on FDAI 1 or 2. This position required when only one FDAI selected.
		7.2.3 Attitude Error Display - CMC Source		Provides G&N computed attitude error in control axes. Information meaningful only when computer program defines desired attitude.
	1	The following are req CMC - on, 8.1.3 ISS - on, 8.1.3		Required to compute error and mode CDUs. Required for attitude information.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	2	Set pwr sw FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position chosen depends on which FDAI(s) desired.
		LOGIC 2/3 PWR - on (up)		Provides power for FDAI switches.
	3	Sel disp scaling FDAI SCALE 5/5 or 5/1	1	Positions provide for compatible scaling between CMC and display electronics in roll axis during orbital flight. If 50/15, 50/10 position chosen, roll scaling 12.5° full scale.
	4	Sel disp configuration		
		a. FDAI SEL - 1/2		Displays attitude error from CDUs on FDAI 1.
or		b. FDAI SEL - 1 or 2 FDAI SOURCE - CMC		Displays attitude error from CDUs on FDAI 1 or 2. This position required when only one FDAI selected.
	7.2.4	Attitude Error Display - Attitude Set Source		Provides methods for displaying attitude difference between attitude set indicators and GDC (body error) or IMU gimbal angles (Euler error). Polarity reversal occurs when ATT SET - IMU option selected and roll gimbal angle >±90°. Pitch and yaw attitude error needles become "fly from" indicators rather than "fly to" indicators in this instance.
	1	Set pwr sw & disp logic FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position depends on which FDAI desired.

ATTITUDE ERROR DISPLAY - ATTITUDE SET SOURCE

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	LOGIC 2/3 PWR - on (up)	7	
	FDAI SEL - 1 or 2	1	Display not available at 1/2 position.
	FDAI SOURCE - ATT SET		Required to enable attitude set input to FDAI.
	.05 G sw - OFF (verify)		On (up) position not desirable (cages BMAGs).
	2 Sel att ref		
	a. SCS		
	ELEC PWR - GDC/ECA	7	Provides power to GDC electronics.
	BMAG 2 PWR - ON		
	ATT SET - GDC	1	
	BMAG MODE - RATE 2 or ATT 1/RATE 2		Switches should be set by axis as desired.
	b. ISS		
	ISS - on, 8.1.3		6.1.1, note 6.
	ATT SET - IMU		
	7.2.5 Total Attitude		Provides methods for displaying Euler angles on FDAI ball from GDC or IMU.
	1 Set pwr sw & enable FDAI		
	FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position depends on which FDAI(s) desired.
	LOGIC 2/3 PWR - on (up)		Supplies power for FDAI, BMAG MODE switches and ATT SET switch (IMU position).
	2 Sel disp & disp source	1	
	a. ISS disp		
	ISS - on, 8.1.3		
	FDAI 1 disp		Enables IMU resolver outputs to FDAI 1 ball drive. There are three possible switch combinations.

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	FDAI SEL - 1/2	1	This position also enables GDC total attitude to FDAI 2.
	or FDAI - 1/CMC FDAI SEL - 1 FDAI SOURCE - CMC		
	or FDAI - 1/ATT SET/IMU FDAI SEL - 1 FDAI SOURCE - ATT SET ATT SET - IMU		6.1.1, note 6.
	FDAI 2 disp FDAI - 2/CMC FDAI SEL - 2 FDAI SOURCE - CMC		Enables IMU resolver outputs to FDAI 2 ball drive. There are two possible switch combinations.
	or FDAI - 2/ATT SET/IMU FDAI SEL - 2 FDAI SOURCE - ATT SET ATT SET - IMU		6.1.1, note 6.
b.	GDC disp ELEC PWR - GDC/ECA	7	Provides power to GDC electronics.
	BMAG 2 PWR - ON BMAG MODE - RATE 2 or ATT 1/RATE 2	1	Switches should be set by axis as desired.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx BMAG 1 PWR - ON (if BMAG 2 fails) BMAG MODE - RATE 1 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	7 1	

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	FDAI 2 disp FDAI SEL - 1/2	1	Enables GDC resolver outputs to FDAI 2 ball drive. There are three possible switch combinations.
	or FDAI - 2/GDC FDAI SEL - 2 FDAI SOURCE - GDC		
	or FDAI - 2/ATT SET/GDC FDAI SEL - 2 FDAI SOURCE - ATT SET ATT SET - GDC		
	FDAI 1 disp FDAI - 1/GDC FDAI SEL - 1 FDAI SOURCE - GDC		Enables GDC resolver outputs to FDAI 1 ball drive. There are two possible switch combinations.
	or FDAI - 1/ATT SET/GDC FDAI SEL - 1 FDAI SOURCE - ATT SET ATT SET - GDC		
	7.2.6 ORDEAL - Local Horizontal Attitude		Provides methods for displaying local horizontal reference established by ORDEAL on FDAI 1 and/or FDAI 2 balls. Only pitch axis affected.
1	Set pwr sw FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position chosen depends on which FDAI(s) desired.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	EARTH/LUNAR - EARTH LTG - BRT or DIM	13	
	2 Sel disp configuration FDAI 1 disp FDAI - 1/ORB RATE FDAI SEL - 1 or 1/2 FDAI 1 sw - ORB RATE	 1 13	Reference system may be GDC or IMU, 7.2.5.
	FDAI 2 disp FDAI - 2/ORB RATE FDAI SEL - 2 or 1/2 FDAI 2 sw - ORB RATE	 1 13	
	FDAI 1 & 2 disp FDAI - both/ORB RATE FDAI SEL - 1/2 FDAI sw (botn) - ORB RATE	 1 13	
	7.3 GDC ALIGN		Aligns GDC to ATT SET thumbwheels.
	ELEC PWR - GDC/ECA	7	Supplies power to GDC electronics.
	ATT SET - GDC	1	Enables attitude set inputs to GDC.
	Verify tw settings		
	GDC ALIGN pb - push		Enables attitude set inputs to GDC and disables BMAG inputs.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	7.4 SPS THRUSTING CONTROL		
	7.4.1 TVC Initialization		Defines safe switch configuration required before initiation of thrusting procedures.
AC	LOGIC 2/3 PWR - on (up)	7	Provides power to SCS TVC switches.
	SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		Required for RCS jet on-off and MTVC TLM.
	SPS THRUST - NORM	1	Lever lock.
	SCS TVC (2) - RATE CMD (if burn is G&N or MTVC)		
or	SCS TVC (2) - AUTO (SCS burn)		
	TVC GMBL DR (2) - AUTO		The 1 or 2 positions may be used as backup if required.
	ATVC GAIN - HI or LO		Required only for SCS/SPS auto thrusting. Position depends on whether auto or manual (tw) control of SPS gimbals desired. LO position provides proper response for tw control of SPS gimbals.
	FDAI/GPI PWR - 1, 2 or BOTH	7	Position chosen depends on whether redundant GPI displays desired. To enable redundant GPI indicators, FDAI/GPI PWR switch must be set to BOTH.
	LV IND/GPI sw - GPI	1	
	7.4.2 SPS Gimbal Control		
1	CMC Cont		
	ISS - on (req), 8.1.3		Provides attitude information and power to ECDUs.
	CMC - on (req), 8.1.3		
	Servo loop activated (step 4)		
	Gmbl mot on		Operating time limited depending on operating conditions. MN BUS TIE (2) must be on before gimbal motors started.
	SC CONT - CMC		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	LOGIC 2/3 PWR - on (up) THC - neut	7	Supplies power to SC CONT switch.
2	SCS Cont - AUTO Servo loop activated (step 4) Gmbl mot on	1	Operating time is limited depending on operating conditions. MN BUS TIE (2) must be on before gimbal motors are started.
	LOGIC 2/3 PWR - on (up)	7	Supplies power to SC CONT, BMAG MODE, SCS TVC, and THC CW switches.
	ELEC PWR - ECA or GDC/ECA BMAG PWR (both) - ON		Supplies power to control electronics. Rate and attitude sensors required.
	BMAG MODE - ATT 1/RATE 2	1	BMAGs in gyro assembly 1 will uncage if MAN ATT switches at RATE CMD. If not, uncaging will occur when IGN 2 logic signal present.
	.05 G sw - OFF (verify) SCS TVC (2) - AUTO IGN 2 logic sig present		On (up) position not desirable (cages BMAGs). Provided by thrust control logic at engine on until 1 second after engine off.
	SC CONT - SCS THC - neut		
or	SC CONT - CMC THC - CW		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	3	MTVC cont - RATE CMD/ACCEL CMD	1	Stick integrator is enabled when IGN 2 logic signal is present. The IGN 2 logic signal present at SPS on until 1 sec after SPS - off, is provided by thrust control electronics.
		Servo loop activated (step 4) Gmbl mot on		Operating time is limited depending on operating conditions. MN BUS TIE A/B or C/D must be on before gimbal motors are started.
		LOGIC 2/3 PWR - on (up)	7	Provides power for SC CONT, BMAG MODE, SCS TVC and THC - CW switches.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2 ELEC PWR - ECA or GDC/ECA BMAG 2 PWR - ON (for RATE CMD) BMAG MODE (3) - ATT 1/RATE 2 or RATE 2 RHC PWR NORM (both) - AC/DC	1	Required for RCS jet on-off and MTVC TLM. Supplies power to RHCs and control electronics. Rate information required for RATE CMD MTVC.
		Rate Cmd		
		a. SCS TVC (2) - AUTO SC CONT - SCS THC - CW		
or		b. SCS TVC (2) - RATE CMD SC CONT - SCS		
	or	SC CONT - CMC THC - CW		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Accel Cmd		
	a. SCS TVC (2) - ACCEL CMD SC CONT - SCS	1	
	or SC CONT - CMC THC - CW		
4	Servo Loop Activation		
	a. Servo loop No. 1 TVC SERVO PWR 1 - AC1/MNA	7	Provides power to clutches and servo drive electronics. Alternate position of this switch (AC2/MNB) should be used only in the event of an AC1 bus failure to provide additional redundancy. AC1/MNA position should be used in all other cases to be compatible with dc power source for gimbal motors (dc MNA bus power).
	TVC GMBL DR (2) - 1	1	
	or TVC GMBL DR (2) - AUTO THC - neut GMBL MOT 1 - operating		No. 1 gimbal motor must be on with no overcurrent failure sensed.
	or TVC SERVO PWR 2 - OFF	7	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		b. Servo loop No. 2		
AC		TVC SERVO PWR 2 - AC2/MNB	7	Alternate position of this switch (AC1/MNA) should be used only in the event of an AC2 bus failure to provide additional redundancy. AC2/MNB position should be used in all other cases to be compatible with dc power source for gimbal motors (dc MNB bus power).
		TVC GMBL DR (2) - 2	1	
		or TVC GMBL DR (2) - AUTO LOGIC 2/3 PWR - on (up) THC - CW	7	Provides power to THC - CW switch.
		or TVC GMBL DR (2) - AUTO GMBL MOT 1 - not operating	1	If No. 1 gimbal motor off or an overcurrent sensed, control transferred to No. 2 servo loop.
		7.4.3 Thrust On-Off Control		
1		CMC Cont		
		ISS - on (req), 8.1.3		
		CMC - on (req), 8.1.3		
		SPS Gmbl Cont (desired), 7.4.2		
		SC CONT - CMC		To satisfy CMC control, THC must not be CW.
		LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch.
		SPS THRUST - NORM	1	DIR ON will override CMC thrust-on control.
		ΔV THRUST A(B) - NORM		Guarded.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Thrust on		
AC		CMC eng on cmd (P40)	1	
		Thrust off		
		CMC eng off cmd (P40)		
		or ΔV THRUST A &/or B - OFF		Guarded.
	2	SCS Cont		
		SPS Gmbl Cont (desired), 7.4.2		
		SC CONT - SCS		
		or SC CONT - CMC		This option may establish SCS MTVC mode depending on position of SCS TVC switches.
		THC - CW		
		LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch.
		SPS THRUST - NORM	1	DIR ON will override SPS thrust control.
		ΔV THRUST A(B) - NORM		Guarded.
		Thrust on		
		ΔV ind - not zero		Required only if EMS FUNC in ΔV or ΔV TEST.
		THC - +X		
		or DIR ULL pb - push		
		THRUST ON pb - push		
		Thrust off		
		EMS FUNC - ΔV		
		ΔV ind - zero		
		or ΔV THRUST A &/or B - OFF		Guarded.

THRUST ON-OFF CONTROL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Dir Cont SPS Gmbl Cont (desired), 7.4.2		
AC		Thrust on ΔV THRUST A &/or B - NORM SPS THRUST - DIR ON	1	Guarded. Lever lock.
		Thrust off ΔV THRUST A &/or B - OFF		Guarded.
		7.5 OPTICS CONTROL		
		7.5.1 Auto Optics Positioning		Permits CMC control of optics.
	1	The following are req ISS - on, & orient known, 8.1.3 & sec 13 CMC - on, 8.1.3 Opt - on, 8.1.4		
CP	2	Establish CMC cont OPT ZERO - OFF OPT TELTRUN - SLAVE TO SXT OPT MODE - CMC	122	Required for SCT trunnion drive.
		7.5.2 Manual Optics Control		Permits manual control of optics using optics hand control (OHC).
	1	The following are req Opt - on, 8.1.4		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	Establish man cont & sighting options	122	
		Optics - MAN/DIR		
		OPT ZERO - OFF		
		OPT MODE - MAN		
		OPT COUPLING - DIR		Permits desired image motion in FOV. In DIRECT mode, OHC left, right motion drives optics shaft, while up, down motion drives trunnion. RSLV mode provides motion resolved into SC body coordinates. Motion appears to be target motion corresponding to direction of OHC movement.
		or Optics - MAN/RSLV		
		OPT ZERO - OFF		
		OPT MODE - MAN		
		OPT COUPLING - RSLV		
		OPT TELTRUN - SLAVE TO SXT		
		or 0°		Provides zeroing of SCT trunnion axis.
		or 25°		Provides greater scanning capability for star sightings.
		OPT SPEED - HI, MED or LO		Set as desired.
		7.5.3 Manual Optics Drive		Permits manual optics operation (no power) using optics tool.
	1	The following are req		
		G/N LTS - AC1 or AC2	100	Supplies power for condition lamps and reticle.
		G/N OPT PWR - OFF		
	2	Obtain opt tool from tool kit		

MANUAL OPTICS DRIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Perform man opt drive RETCL BRT tw - as req SHAFT - as desired TRUN - as desired	122 121	
		7.6 ENTRY MONITOR SYSTEM (EMS)		
		7.6.1 ΔV Test & Null Bias Check		
AC	1	Initial EMS prep EMS FUNC - OFF (verify) cb EMS (2) - close (verify) EMS MODE - STBY	1 8 1	
	2	EMS FUNC - ΔV SET Adj alphanumeric brightness (option) EMS MODE - NORM Set ΔV ind to +1586.8 fps		Enables slewing of ΔV ind. 6.1.1, note 10.
	3	EMS FUNC - ΔV TEST SPS THRUST lt - on ΔV ind decr (10 sec) SPS THRUST lt - out ≈-0.1 fps on ΔV ind ΔV ind stops at -0.1 to -41.5 fps		ΔV TEST checks ΔV circuitry.
	4	EMS MODE - STBY		
	5	EMS FUNC - ΔV SET Slew ΔV ind to -100.0 fps		ΔV indicator zeroed to start accelerometer null bias check.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Report ΔV ind reading to STDN	1	Used by STDN with data recorded in step 9 to calculate ΔVc for use on next burn.
CP	6	CMC MODE - FREE (til meas complete)		Inhibits auto RCS jet firings which could create ΔV's during the bias measurement.
	or	BMAG MODE (3) - RATE 2		
	or	MAN ATT (3) - ACCEL CMD		
AC	7	EMS FUNC - ΔV (wait 5 sec)		Allows accelerometer time to stabilize before switching from STBY mode.
T=0	8	EMS MODE - NORM		
T-100 sec	9	EMS MODE - STBY Rcd ΔV ind & report to STDN		
		If ΔV drift $\leq$1 fps, do not bias counter		Acceleration $\leq$0.01 fps^2.
		If ΔV drift >1 fps but <10 fps bias if desired		Acceleration $\geq$0.01 fps^2 but <0.1 fps^2. Counter bias not required for SPS ΔV.
		If ΔV drift >10 fps, EMS is no-go for all functions		Acceleration >0.1 fps^2.
		CAUTION Do not turn EMS FUNC - OFF prior to ΔV, or null bias will be invalid.		

ΔV TEST & NULL BIAS CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.6.2 ΔV Setup		Specifies required steps necessary to initialize EMS for monitoring ΔVs and to generate the SPS engine cutoff signal for SCS controlled SPS ΔVs.
		ΔV TEST & NULL BIAS CHECK (desired), 7.6.1		
AC		cb EMS (2) - close	8	
	1	EMS MODE - STBY EMS FUNC - ΔV SET	1	
	2	Set ΔV ind - req ΔV		
	3	EMS FUNC - ΔV		6.1.1, note 10.

8.0 G&C GENERAL PROCEDURES

The procedures in this section involve both the G&N and SCS and are used most frequently during the orbital phase. Because they are fundamental to G&C operation, they are included or referenced in various forms in the more complex G&C procedures contained in sec 9 through sec 21.

Applicable G&C Reference Modes, sec 7, have been referenced throughout these procedures.

For general G&C operating data, refer to operating notes, 6.1.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.1 G&N GENERAL		
		8.1.1 (P00) CMC Idling Program		Indicates that CMC in operate condition but not performing control or computation operations requiring coordination with other crew tasks. Maintains CMC in readiness for entry into most programs. CSM and Soyuz state vectors and W-matrix (rendezvous) are updated. (Refer to 5.6.12 of R-693, section 5.)
CP		Key V37E 00E DSKY - P00	2,140	
		8.1.2 CMC/IMU Power Down		
		(P06) CMC Power Down		Transfers CMC from operate to standby. V69E may be used to recover from an inadvertent entrance into P06. Otherwise, when P06 selected, CMC must be powered down to standby.
	1	Key V37E 06E DSKY - P06		
	2	FL V50 N25 00062 (CMC pwr down) PRO (push till STBY lt - on) CMC blanks DSKY disp		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		IMU Power Down		Transfers IMU from operate to standby.
AC	1	CMC MODE - FREE	1	
CP	2	G/N IMU PWR - OFF	100	Guarded. Loss of IRIG wheel power will send IMU FAIL discrete to CMC. 5 minutes should be allowed between IMU power down and ISS startup to permit gyro rundown prior to re-applying power (minimizes possibility of damaging gyros).
	3	If CMC operating Key V37E XXE	2,140	Select program not requiring IMU.
		CAUTION Only in case of emergency shall IMU be powered down beyond stby:		If standby power removed for >20 minutes, ISS calibration no longer valid.
DP		cb G/N IMU HTR (2) - open	5	
		8.1.3 Startup		Transfers ISS/CMC from standby to operate condition. Startup procedure will be first procedure selected after returning from standby, since time 2/time 1 is invalid until this is done.
		CMC Startup		
		C/W INPUT 10C - ENBL (verify)	201	Enables C/W input to CMC warning light (panel 2).
CP		PRO - (push until STBY lt out) Poss CMC warning lt (20 sec max) Poss RESTART lt - on Poss PROG alarm RSET DSKY - P06 FL V37 Key 00E	2,140	When PRO released, CMC may revert to STBY mode. Repeat PRO until STBY light out. These alarms should be ignored if they can be reset.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If state vctr update		
SPT		Key V96E	2,140	V96E suspends state vector integration.
		Perform CSM - (P27) CMC Update, 8.1.5		
		Key V37E 00E		Re-enables P00 integration suspended by V96E.
		Key V37E XXE		
		ISS Startup		5 minutes should be allowed between IMU power down and ISS startup to permit gyro rundown prior to re-applying power (minimizes possibility of damaging gyros).
		If CMC on		
		C/W INPUT 10D - ENBL (verify)	201	Enables C/W input to ISS warning light (panel 2).
		G/N IMU PWR - on (up)	100	Guarded.
		NO ATT lt - on (90 sec)	2,140	
		NO ATT lt - out (wait 15 sec)		15 seconds allows PIPA inhibit reset.
		Key V37E XXE		Select IMU alignment program desired.
		If CMC not on		
		G/N IMU PWR - on (up)	100	Guarded. IMU drives to 0,0,0.
		Wait 90 sec		
CDR		IMU CAGE - on (up) ≈5 sec then off (down)	1	Guarded. Releases IMU.
	8.1.4	Optics Power Control		
	1	Opt pwr up		6.1.3, note 4g.
SPT		G/N LTS - AC1 or AC2	100	Provides power to reticle and condition lights in LEB.
		OPT ZERO - OFF	122	OPT ZERO switch should be left at ZERO until optics use required. It is not position of this switch, but change to ZERO position that triggers zeroing routine.
		OPT MODE - MAN		
		G/N OPT PWR - on (up)	100	
		OHC - drive trun <10°		
		OPT ZERO - ZERO (≈15 sec to zero)		
		COND LAMPS - ON		
		RETCL BRT tw - adj		

OPTICS POWER CONTROL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Opt pwr down		6.1.3, note 4g.
CP		OHC - drive trun <10°		
		OPT ZERO - ZERO	122	
		G/N OPT PWR - OFF	100	
		G/N LTS - OFF		Removes power from reticle and condition lights in LEP.
		8.1.5 (P27) CSM - CMC Update		P27 may be entered only from P00, P02, P20 (options 1, 2, 5), or after V96E.
		CMC - on (req), 8.1.3		
		If P00, P02, P20 (opt 1, 2, 5) or V96E		
		Go to 1		
		If other		
		Key V96E	2,140	
	or	Key V37E 00E		
		Auto Update		
	1	UP TLM CM - ACPT	2	
		UP TLM - ACPT	122	
		UPLINK ACTY lt - on		
	2	Update complete		
		UPLINK ACTY lt - out	2,122	
		DSKY P00/P02/P20		
		UP TLM CM - BLOCK	2	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		or UP TLM - BLOCK	122	
		Voice Transmission Update		
	1	Liftoff time - V70E		
		or Load data block - V71E		
		or Load singular data - V72E	2,140	
		or Oct time increment - V73E		
		Poss OPR ERR		If another extended verb active.
	2	DSKY - P27		P27 may be terminated by responding to flashing display with V34E. Data will not be incorporated for use by CMC.
	3	FL V21 N01 R1 Blank R2 Blank R3 AAAAA		
		Key in update data, XXXXXE (R1) CMC increments R3 by 1		
		Repeat 3 until all data loaded		
	4	FL V21 N02 R1 Blank R2 Blank R3 00330		

(P27) CSM - CMC UPDATE

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept update V33E	2,140	6.1.3, note 3m.
	P00, P02 or P20 - sel auto		Data transferred from buffer storage to appropriate cells
	If V96 previously keyed Key V37E 00E		Reinstates periodic P00 integration.
	Reject update Load Oct ID (XXE) of word to be corrected Return to 3		
	Time Update (Decimal)		
	1 Key V55E		
	Poss OPR ERR		If another extended verb active.
	2 FL V21 N24 (V25)		All registers initially blank.
	Δ time (CMC clock) 00XXX. HRS 000XX. MIN 0XX.XX SEC		Delta time change must all be provided in decimal.
	Accept Load ΔT		CMC adds ΔT to CMC clock time.
	Reject V33E		6.1.3, note 3m. V33E or V34E does not update clock time.
	or V34E		
	3 Check Updated CMC Time Key V06 N65E Key V37E 00E		DSKY displays R1, R2, R3 for crew verification. CMC returns to P00.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Erasable Memory Update		
CP	1	Key V37E 00E	2,140	
	2	For Consecutive Address V21 N01E Load first address XXXXE Load first data word XXXXXE N15E Verify CMC increments address by one (R3) Load second data word XXXXXE,E Load third data word XXXXXE,E Continue until last address in seq filled		
	3	For Non-consecutive Address V21 N01E Load first address XXXXE Load first data word XXXXXE,E Load second address XXXXE Load second data word XXXXXE,F		
	4	To Monitor-Data Loaded in Consecutive Address V01 N01E Load first address XXXXE Check first data word in R1 N15E Check second data word in R1 ENTR Check third data word in R1 ENTR		

(P27) CSM - CMC UPDATE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	To Monitor Data Loaded in Non-consecutive Address V01 N01E Load first address in R3 XXXXE Check first data word in R1 ENTR Load second address in R3 XXXXE Check second data word in R1 ENTR	2,140	
		8.1.6 (P47) G&N Thrusting Monitor Program		Monitors vehicle acceleration during non-G&N controlled thrusting maneuvers, and displays ΔV applied to vehicle by thrusting maneuver. Selection of P47 during P20 destroys least significant half of N78 (R1). Refer to P20, 10.2.1.
		CMC - on (req), 8.1.3 ISS - on & aligned (req), 8.1.3 & sec 13 CMC ATT - IMU (verify)		
	1	Key V37E 47E	2	G&N monitor of ΔV highly desirable, if available, but not a requirement. P47 should be called just prior to thrusting and terminated as soon as possible thereafter in order to minimize errors of bias and average G. Range, range rate, and theta may be displayed by using V83 (R31). Range, range rate, and phi may be displayed during P47 by using V85 (R34). Orbital parameters may be displayed by using V82 (R30). Also, an SCS orbit change can be monitored by P40 if properly combined with G&N Prethrusting and Thrusting Procedures, sec 11 and sec 12. N62 (VI, H dot, H) available during P47.
		Poss PROG alarm (8.1.15)		R02.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V16 N83 ΔVX, Y, Z (cont) XXXX.X FPS	2	Displayed when average G turned on. CMC requires 12.5 seconds to turn on average G if integration required is < a time step plus 1.4 seconds for each additional time step. Time step = 240 seconds.
		(To rezero registers - V32E)		Provides capability to monitor another burn without going through R00.
		Monitor for burn completion Rcd ΔV PRO (exit P47)		When P47 termination desired.
	3	FL V37 Key XXE		If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
		8.1.7 (P48) Rendezvous Thrust Monitor		Monitors vehicle acceleration during non-G&N controlled thrusting maneuvers, and displays ΔV applied to vehicle by thrusting maneuver. The program also displays range and range rate (R & R dot) from a source independent of vehicle state vectors (i.e., VHF, R27), and provides the opportunity to specify a time at which R & R dot will be optimized by loading N72 with the desired time.
		CMC - on (req), 8.1.3 ISS - on & aligned (req), 8.1.3 & sec 13 VHF - on (req), 5.6.3 CMC ATT - IMU (verify) .C5G sw - OFF (verify)		
	1	If MINKEY auto call Go to 2		P48 should be called just prior to thrusting (allow time for R27 convergence) and terminated as soon as possible thereafter in order to minimize errors of bias and average G.
or		Key V37E 48E	2,140	

(P48) RENDEZVOUS THRUST MONITOR

STA/T STEP	PROCEDURE	PANEL	REMARKS
			Range, range rate, and theta/phi (as calculated from state vectors) may be displayed during P48 by using V83 (R31) and V85 (R34) respectively. Additionally, orbital parameters may be displayed by using V82 (R30). Optimization time [T (R27 optimized) in N72] is initialized to zero (for current time) and may be changed by V25 N72E and loading desired time (step 2).
CF	Poss PROG alarm (8.1.15)	2,140	R02.
2	FL V16 N77		
	R XXX.XX NM		VHF range to Soyuz.
	R dot (- closing) XXXX.X FPS		Range rate.
	θ XXX.XX DEG		Angle between CSM +X and local horizontal plane (0 to 360°). P48 initializes θ to -00001.
	Accept PRO, go to 4 Reject V32E If N72 = 0, recycle 2 If N72 ≠ 0, go to 3		Reinitializes N83 cells. N77 current/optimized values are defined as follows: If N72 = 0; R, R dot, & θ = current values. If N72 ≠ 0. -01B35 < TFO < +00B02, R & R dot = fixed at last current value. +00B02 < TFO < +01B35, R & R dot = optimizing values. TFO > 01B35, R & R dot = optimized values. TFO < -00B20, θ = current value. -00B20 < TFO < +00B02, θ = -00001. TFO > +00B02, θ = optimized value. New optimization is done every 4 minutes.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	To optimize N77 values		
CP	Key V25 N72E	2,140	Initialized zero upon P48 entry.
	T (R27 optimized) 00XXX. HRS 000XX. MIN 0XX.XX SEC		GET at which optimized R, R dot & θ desired.
	Load desired optimization time V32E, go to 3		
3	FL V16 N76		For TFO (-01B35 < TFO < +01B35), R & R dot are being optimized, otherwise R & R dot are current values.
	R XXX.XX NM		VHF range to Soyuz.
	R dot (- closing) XXXX.X FPS		Range rate.
	TFO XXBXX MIN-SEC		Time from optimization (determined by N72). +59B59 if no optimization requested.
	Accept PRO, return to 2 Reject V32E, recycle 3		Reinitializes N83 cells.
4	FL V16 N83		
	ΔVX, Y, Z (cont) XXXX.X FPS		Initially zero. Updated at 2-second intervals.
	Accept PRO, go to 5 Reject V32E If N72 = 0, return to 2 If N72 ≠ 0, return to 3		To re-initialize N83.
5	FL V37 Key XXE		

(P48) RENDEZVOUS THRUST MONITOR

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.1.8 CMC Self-Check Procedure		Procedure used to check CMC's ability to write into and read out of erasable memory and performs internal fixed memory banksum.
		CMC - on (req), 8.1.3		
CP	1	Key V25 N01E 1365E E, E, E	2,140	Zero self-check cells: ERCOUNT, SCOUNT, SCOUNT +1.
	2	Key V15 N01E - establish monitor of self-check 1365E		Begin monitor of self-check cells.
	3	Key V21 N27E 10E - starts self-check		Starts complete self-check.
	4	Monitor R2 & PROG lt		
		a. R2 becomes >3 Self-check has been successfully completed at least once Key V21 N27E 0E terminates self-check		Turns off self-check.
		b. If PROG lt comes on Coord with STDN &/or perform G/N malfunc SSR-1		
		8.1.9 Measurement and Loading of PIPA Bias		
		CMC - on (req), 8.1.3 ISS - on (req), 8.1.3		ISS should be on at least one hour prior to performing this procedure to allow PIPAs to stabilize.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		SCS - on (desired), 8.4.2		Provides display and SCS control capability.
AC		CMC ATT - IMU (verify)	1	
		.05 G sw - OFF (verify)		
		LOGIC 2/3 PWR - on (up)	7	
	1	Set Evnt Tmr 00:00	1	
	2	Sel Att Cont desired, 7.1 Maintain SC Rates <0.1°/sec		
AC,CP				
00:00	3	Key V25 N21E, E, E, E/start Evnt Tmr	2,140	Zeros noun 21 cells.
CP	4	Key V06 N21 (do not ENTR)		
01:04	5	Key ENTR		
	6	Rcd PIPA counts (X)R1____(Y)R2____(Z)R3____ ±XXXAB		If PIPA count > 99 (XXX≠000), CMC incapable of adjusting PIPA bias.
	7	Key V21 N01E (adj PIPA bias) Load 1452E (calculated X bias) ±AB000E, E 1454E (calculated Y bias) ±AB000E, E 1456E (calculated Z bias) ±AB000E		
	8	Key V37E 00E		

MEASUREMENT AND LOADING OF PIPA BIAS

STA/T STEP	PROCEDURE	PANEL	REMARKS

8.1.10 ΔR and ΔV Threshold Change Procedure

CMC - on (req), 8.1.3

CP Key V24 N01E 2,140
Key 2002E

Load erasable value for desired ΔR
(from following table)

Load erasable value for desired ΔV
(from following table)

Desired ΔR NM	Erasable Value	Desired ΔV FPS	Erasable Value
0.00	77776	0.00	77776
0.001	0	0.0001	0
0.1	6	2.5	1
0.2	14	5.12	2
0.3	21	7.68	3
0.4	27	10.24	4
0.5	35		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	8.1.11 Flagword Monitor and Change Procedure		
CP	Flagword Monitor		
	Key V10 N01E Key XXXE (flagword address)		6.9 for flagword addresses.
	R1 XXXXX (flag bit) R3 OOXXX (flagword address)		
	Check flag bit in R1 KEY REL		
	Flagword Change		
	Key V25 N07E Key XXXE (flagword address)	2,140	ECADR ≤30 (octal) will select appropriate channel (except that channel 7 attempts will be ignored).
	Key XXXXXE (bit ID) Key 1 or 0 (1 = set flag bit, 0 = reset flag bit)		Load code for bit to be changed (bit ID) as follows:

	A			B			C			D			E		
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
code	4	2	1	4	2	1	4	2	1	4	2	1	4	2	1

FLAGWORD MONITOR AND CHANGE PROCEDURE

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Example: To set REFSMFLG (flagword 3, bit 13) Key V25 N07E 77E 10000E 1E		
3.1.12	Chan 31/33 Control Mode Override (C31FLWRD)		Provides flexibility for crew to specify desired control mode (via C31FLWPD) if, because of hardware failure, SC CONT, CMC MODE, OPT MODE, and OPT ZERO switch position changes are not recognized by CMC. C31FLWRD is an erasable memory cell of the form AXXDX and must be manually loaded; A & D preferably padloaded zero. Used by CMC to determine whether channel 31 and 33 representation of control switch configurations are to be used, or if backup indicators are to be used.
	Key V21 N01E 03737E FL V21 N01 AXXDX (C31FLWRD)		A = 0 or 4 (Chan 31 bits 13, 14, 15 = valid control mode representation). D = 0 or 4 (Chan 33 bits 4, 5 = valid control mode representation).

STA/T STEP	PROCEDURE	PANEL	REMARKS
			A or D ≠ 0 or 4 (CMC uses A or D as backup indicator of desired control mode as loaded in R1 from the following):
JI	Load A (or D) B/U option in R1		Digit A backup option: 1 - G&N control FREE 2 - G&N control ATT HOLD 3 - G&N control AUTO 5 - | 6 - | 7 - | SCS control modes
	ENTR	2,140	Digit D backup option: 1 or 5 - OPT mode CMC 2 or 6 - OPT mode ZERO 3 or 7 - OPT mode MAN
	8.1.13 G&N Passive Thermal Control Procedure		Nominal G&N PTC and orb rate capabilities contained in Universal Tracking (P20) procedures, 10.2.1. For SCS passive thermal control procedures, refer to 8.4.9 and 10. Refer to 8.2.5 for PTC (P20 option 2) procedures.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 RCS DAP - Load & activate (req), 8.2.1		0.5° deadband and 0.2°/second rate recommended.
1	Perform (V49E) R62, 8.3.4 (PRO on auto mnvr req, FL V50 N18)		This option required to ensure erasable memory is properly set up.

G&N PASSIVE THERMAL CONTROL PROCEDURE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC CF	2	Disable two adjacent RCS quads Att hold for 20 min	8	Provides fuel conservation and lower rates (panel 8 switches or R03 may be used to disable engines).
AC	3	MAN ATT P&Y (2) - ACCEL CMD Enable all RCS jets	1 8	
CF	4	Set att hold Key V21 N01E 1330E, E (Set HOLDFLAG zero)	2,140	Sets HOLDFLAG zero and inhibits maneuver until after data load.
		Establish desired rate		
	5	Start roll mnvr Key V21 N01E 1330E 70000E		Initiates maneuver.
AC	6	MAN ATT ROLL - ACCEL CMD	1	Disables roll jets for duration of PTC.
CF	7	Perform PCS DAP Att Dbd Change, 8.2.3		±30° deadband is recommended.

+0.1°/sec	-0.1°/sec	+0.3°/sec	-0.3°/sec
V24 N01E	V24 N01E	V24 N01E	V24 N01E
3154E	3154E	3154E	3154E
3E	77774E	12E	77765E
24400E	53400E	35400E	42400E
V21E	V21E	V24E	V24E
3227E	3227E	3226E	3226E
35101E	42676E	2E	77775E
		27303E	50474E

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	c	AUTO RCS (16) - OFF	1	
	9	To term PTC MAN ATT (3) - ACCEL CMD (verify) AUTO RCS (16) - MNA or MNB V46E or Cycle SC CONT sw MAN ATT (3) - RATE CMD	8 1	Re-establishes attitude hold within attitude deadband selected in P03.
		6.1.14 Saturn Rate Change		
		CMC - on (req), 6.1.3		
CP	1	Key V24 N01E 3342E XXXE YYYYYE	2,140	

SIVB RATE	SAT RATE +1 (3342) XXX	SAT RATE +2 (3343) YYYYY
0.05°/sec RPY	161	77616
0.1°/sec RPY	210	77567
0.2°/sec RPY	266	77511
0.3°/sec RPY	344	77433
0.5°/sec P, 0.3°/sec P&Y	476	77301

SATURN RATE CHANGE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		6.1.15 (R02) IMU Status Check		Checks whether IMU aligned to an orientation known by CMC and, if not, whether it is on. R02 automatically called by programs requiring ISS. Provides for program alarms if ISS not on and/or IMU orientation unknown.
	1	ISS not on		
CP		PROG alarm	2,140	Occurs only if ISS not on.
		FL V37		
		Key V05 N09E (to verify alarm)		Alarm stored; must key V05 N09E to display alarm code.
		00210 (ISS not on)		
		Perform ISS turnon		
		Key XXE		Return to PXX at completion of ISS turnon.
	2	ISS on but orientation unknown		
		PROG alarm		
		Key V05 N09E (to verify alarm)		Alarm stored; must key V05 N09E to display alarm code.
		00220 (IMU orient unknown)		
		FL V37		RSET and KEY REL pressed when nature of problem determined. When CMC regains control, program cycles through R00, which may set or reset RNDVZFLG, TRACK, and UPDATE flags, depending on which programs are in progress or called.
		Key XXE		Reinitiate desired program.

START STEP	PROCEDURE	PANEL	REMARKS
	8.1.1t DSKY 8's Clear Procedure		DSKY relay failure mode will cause an all-eights display on DSKY. Affects display capability of DSKY but will not affect input/output or control functions.
CP	Key V35 N99 Key V37 N01E 00000E +99999E +99999E +99999 CLR, CLR, CLR 00000E 00000E 00000E If OPR ERR Start over If DSKY does not clear Repeat proced	2,140	
	8.1.17 Backup CMC Clock Initialization TBD		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	8.2 DIGITAL AUTOPILOT (DAP)		
	8.2.1 (V48) Undocked DAP Data Load (R03)		For CMC control modes (CSM alone), DAP data load procedure is used to select rate, deadband, and quads. When under computer control, operating program will establish SC rates and attitude error deadbands, or crew may select other desired error deadbands via DSKY. In addition, crew has capability of selecting RCS quads for computer command of manual translation, attitude hold, or automatic and manual manuvers. Also refer to 6.1.1, note 16.
	CMC - on (req), 8.1.3		
1	Key V48E	2,140	Extended verb 48 program calls DAP data 1, 2, and 3 in sequential order. DAP data 1, 2, or 3 may also be displayed individually by using respective verb/ noun combinations, i.e., V04 N46, V06 N47, or V06 N48.
2	FL V04 N46 R1 - A B C D E R2 - A B C D E Accept PRO Reject V24E load desired data		If quads A/C and B/D (4 jets) desired for +X translation, R1-B and R1-C may be set to 0,0, or 1,1. For operational considerations, R1-A codes 2 & 6 are referred to as (CSM & Soyuz) and (CSM & DM) respectively; however, the MIT software listing for these codes are (CSM & LM) and (CSM & LM ascent stg only). If A is failed, CMC assumes C is good. If B is failed, CMC assumes D is good.

R1

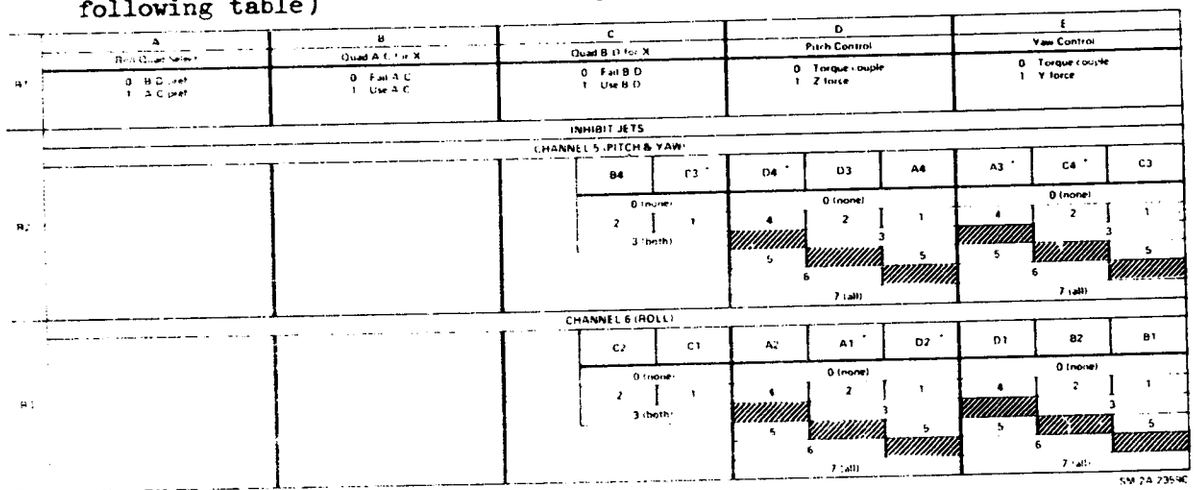
Vehicle Config	Quad A-C for $\ddot{X}$	Quad B-D for $\ddot{X}$	Err Deadband	Rate Select
0 = No Dap 1 = CSM 2 = CSM & SOYUZ 3 = CSM & S-IVB 4 = CSM & DM	0 = Fail A-C 1 = Use A-C	0 = Fail B-D 1 = Use B-D	0 = ± .05° 1 = ± .50°	0 = 0.05°/sec 1 = 0.2°/sec 2 = 0.5°/sec 3 = 2.0°/sec

R2

Rcs Quad Select	Quad A	Quad B	Quad C	Quad D
0 = Use B-D 1 = Use A-C	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	FL V06 N47 CSM wt XXXXX. LBS	2,140	Value of mass used in non-DAP coding not updated unless vehicle configuration digit is 1. P40 reduces value for weight linearly, as function of SPS maneuver time. Maneuvers performed without using P40 could cause CMC's knowledge of weight to be compromised.
		Other vehicle wt XXXXX. LBS Accept PRO Reject Key V21E, V22E or V24E Load correct data		This may be either the DM weight or the Soyuz weight if R03 is selected for control.
	4	FL V06 N48 P Trim XXX.XX DEG Y Trim XXX.XX DEG Accept PRO - Return to prog in progress Reject Key V21E, V22E or V24E Load correct data		If burn >0.42 second, trim values will be updated by CMC during burn. Do not load engine gimbal trim angles >9°.
	5	To activate DAP		To be done first time DAP started or after fresh start.
AC		CMC MODE - FREE	1	Prevents inadvertent jet firings.
CP		Key V46E	2,140	Activates R03.
	8.2.2	(V44) Docked DAP Data Load (R04)		For CMC control modes, DAP data load procedure is used to select rate, deadband, and jets. When under computer control, operating program will establish SC rates and attitude error deadbands, or crew may select other desired deadbands via DSKY. In addition,
		CMC - on (req), 8.1.3		
	1	Key V44E		

STA/T STEP	PROCEDURE	PANEL	REMARKS
			crew has capability of selecting RCS jets for computer command of manual translation, attitude hold, or automatic and manual maneuvers. Included under the maneuver functions are the automatic tracking and universal pointing options of P20. Also refer to 6.1.1, notes 16 and 17.
CP 2	FL V05 N87 R1 - ABCDE (quad sel & cont) R2 - 00CDE (CH5FAIL) R3 - 00CDE (CH6FAIL) Accept PRO Reject Key V25E Load desired data (from following table)	2,140	If A/C used for X translation, force control preference should be specified for pitch. If B/D used, force control preference should be specified for yaw. Figure 6-13 describes jet selection options for torque couples or force pairs when docked CSM controlled maneuvers are desired.



* Normally inhibited while docked to Soyuz

To re-enable inhibited jets Key V59E	Re-enables all jets previously inhibited in R04.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	FL V06 N89 DAP rate X.XXXX DEG/SEC DAP DBD XXX.XX DEG Accept PRO (exit R04) Reject Key V21E, V22E or V24E Load correct data	2,140	
	4	To activate DAP CMC MODE - FREE Key V45E		To be done first time DAP started or after fresh start. In addition, V45E is necessary if R04 re-entered to change DAP deadband (N89). Prevents inadvertent jet firings. Activates DDAP and inhibits UDAP functions. P40 selected and V45E = OPR ERR. Once DDAP has been activated and attempt is made to fire jets, alarms 00500 and/or 00501 may occur. The alarms will not be repeated until R04 is again performed (flags associated with alarms are reset in R04, and set after DDAP activation if insufficient jets available for control of vehicle). R04 jet selection should be examined for sufficient jets enabled to allow DDAP to control vehicle.
		8.2.3 RCS DAP Attitude Deadband Change Procedure CMC - on (req), 8.1.3 ISS - on (req) & orient known (desired), 8.1.3 & sec 13 RCS DAP - activate (req), 8.2.1 SCS - on (desired), 8.4.2		This procedure will change RCS DAP (UDAP) att deadband to ±2.5, 10, 15, 20, 25, or 30°. Additional method of establishing desired deadbands is via N79 load in P20 procedures.
	1	Sel CMC Att Cont - auto, 7.1.6		
	2	Sel 5.0° dbd in RCS DAP, 8.2.1		

RCS DAP ATTITUDE DEADBAND CHANGE PROCEDURE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Key V21 N01E 3306E Load D Band (see table)		

Desired dbd	D Band
±2.5°	0343E
±10°	1616E
±15°	2525E
±20°	3434E
±25°	4343E
±30°	5252E

	4	To return to 5.0° dbd THC - CW, then neut		Center of deadband shifted.
		or Key V48E PRO PRO PRO	2,140	Center of deadband not affected.
		8.2.4 RCS DAP Orbital Rate Procedure		P20 (option 2) may be used to effect orb rate. P20 universal tracking (options 1 and 5) may be used, operationally, to produce a maneuver similar to orb rate. (These options provide a computed maneuver to maintain a specified body vector aligned with the LOS to the celestial body specified, as opposed to a "rate" type maneuver; e.g., option 2.) Refer to 8.2.6 for Orb Rate (P20 option 2) procedures.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1 Ysm aligned to $\underline{V} \times \underline{R}$ (If $\underline{R} \times \underline{V}$, complement numbers for ZZZZZ)		
	1	Perform (V49) R62, 8.3.4 Load gmbl angles for init of orbrate		Gimbal angles loaded are those that are to be at initiation of orbital rate rotation (necessary to initialize erasable memory). MGA should be zero.
	2	If desired Key V37E 00E (non-att cont prog)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Establish orbrate For rates 0.1°/sec or less, load oct numbers corresponding to desired mnvr rate from following table For rate 0.5°/sec, go to 5		
		Key V21 N01E 1330E,E (Set HOLDFLAG zero)	2,140	Sets HOLDFLAG to zero and inhibits maneuver until after data load.
		Key V24 N01E 3156E VVVVVE WWWWWE		
		Key V24E 3160E XXXXXE YYYYYE		
		Key V21E 3231E ZZZZZE		
		Key V21E 1330E 70000E (Set HOLDFLAG negative)		Final ENTR initiates maneuver.
		Mnvr in progress		

RCS DAP ORBITAL RATE PROCEDURE

STA/T STEP	PROCEDURE				PANEL	REMARKS
	4 To term mnvr, go to 8					
		CDUX				
	OREBRATE deg/sec	0 deg	+90 deg	+180 deg	+270 deg	
	-0.100	VVVVV = 77774 WWWWW = 54300 XXXXX = 00000 YYYYY = 61300 ZZZZZ = 42676	00000 61300 00003 23500 42676	00003 23500 00000 16500 42676	00000 16500 77774 54300 42676	
	-0.095	VVVVV = 77774 WWWWW = 62200 XXXXX = 00000 YYYYY = 62000 ZZZZZ = 44250	00000 62000 00003 15600 44250	00003 15600 00000 16000 44250	00000 16000 77774 62200 44250	
	-0.090	VVVVV = 77774 WWWWW = 70000 XXXXX = 00000 YYYYY = 62600 ZZZZZ = 45622	00000 62600 00003 10000 45622	00003 10000 00000 15200 45622	00000 15200 77774 70000 45622	
	-0.085	VVVVV = 77774 WWWWW = 75600 XXXXX = 00000 YYYYY = 63400 ZZZZZ = 47173	00000 63400 00003 02200 47173	00003 02200 00000 14400 47173	00000 14400 77774 75600 47173	
					...continued	

RCS DAP ORBITAL RATE PROCEDURE

STA/T STEP	PROCEDURE			PANEL	REMARKS
ORBRATE deg/sec	CDUX 0 deg	+90 deg	+180 deg	+270 deg	
-0.080	VVVVV = 77775 WWWWW = 43400 XXXXX = 00000 YYYYY = 64100 ZZZZZ = 50545	00000 64100 00002 34400 50545	00002 34400 00000 13700 50545	00000 13700 77775 43400 50545	
-0.075	VVVVV = 77775 WWWWW = 51300 XXXXX = 00000 YYYYY = 64700 ZZZZZ = 52117	00000 64700 00002 26500 52117	00002 26500 00000 13100 52117	00000 13100 77775 51300 52117	
-0.070	VVVVV = 77775 WWWWW = 57100 XXXXX = 00000 YYYYY = 65500 ZZZZZ = 53467	00000 65500 00002 20700 53467	00002 20700 00000 12300 53467	00000 12300 77775 57100 53467	
-0.065	VVVVV = 77775 WWWWW = 64700 XXXXX = 00000 YYYYY = 66300 ZZZZZ = 55041	00000 66300 00002 13100 55041	00002 13100 00000 11500 55041	00000 11500 77775 64700 55041	

...continued

RCS DAP ORBITAL RATE PROCEDURE

STA/T STEP	PROCEDURE				PANEL	REMARKS
	CDUX					
ORBRATE deg/sec	0 deg	+90 deg	+180 deg	+270 deg		
-0.060	VVVVV = 77775 WWWWW = 72500 XXXXX = 00000 YYYYY = 67100 ZZZZZ = 56413	00000 67100 00002 05300 56413	00002 05300 00000 10700 56413	00000 10700 77775 72500 56413		
-0.055	VVVVV = 77776 WWWWW = 40300 XXXXX = 00000 YYYYY = 67600 ZZZZZ = 57765	00000 67600 00001 37400 57765	00001 37400 00000 10200 57765	00000 10200 77776 40300 57765		
-0.050	VVVVV = 77776 WWWWW = 46200 XXXXX = 00000 YYYYY = 70400 ZZZZZ = 61337	00000 70400 00001 31600 61337	00001 31600 00000 07400 61337	00000 07400 77776 46200 61337		
CP 5 Ysm aligned to V x R (If R x V, complement numbers for AAAAA and ZZZZZ)					2,140	
6 Key V21 N01E 1330E,E (set HOLDFLAG zero)						Sets HOLDFLAG zero and inhibits maneuver until after data load.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	7	Establish orbrate (0.5°/sec) Load oct numbers corresponding to mnvr rate from following table Key V24E 3156E VVVVVE WWWWWE Key V24E 3160E XXXXXE YYYYYE Key V24E 3230E AAAAAE ZZZZZE Key V21E 1330E 70000E (set HOLDFLAG negative)	2,140	Final ENTR initiates maneuver.

	CDUX			
	0°	180°	7.25°	187.25°
VVVVV	77755	00022	77722	00022
WWWWW	76077	01700	71351	06426
XXXXX	77775	00002	---	---
YYYYY	66367	11410	---	---
AAAAA	77773	77773	77773	77773
ZZZZZ	56272	56272	56272	56272

RCS DAP ORBITAL RATE PROCEDURE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	S	To term mnvr CMC MODE - HOLD	1	
CP		or Key V49E, return to 1	2,140	
		or Key V46E		
		or RHC - out of detent		
		or Key V37E 00E		
		8.2.5 PTC (P20 option 2)		Provides PTC maneuver by implementing P20 rotation (option 2). Also refer to 6.1.3, note 3r.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1		Provides display and SCS control capability.
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify) LOGIC 2/3 PWR - on (up)	1	If SCS - on option not selected.
	1	RHC (2) - LOCKED FDAI SCALE - 5/1		
	2	Mnvr to PTC att Perform V49 (R62), 8.3.4		
		When att satisfactory, damp vehicle rates Disable all jets on two adjacent quads		Final ENTR in V49.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Sel single jet (roll) compatible with DAP load		
		Wait 20 min		To damp existing vehicle rates.
	3	Configure RCS jets		
		+ Roll		
AC		AUTO RCS A/C ROLL A1, C1 - MNA or MNB	8	
		or AUTO RCS B/D ROLL B1, D1 - MNA or MNB		
		- Roll		
		AUTO RCS A/C ROLL A2, C2 - MNA or MNB		
		or AUTO RCS B/D ROLL B2, D2 - MNA or MNB		
		AUTO RCS (remaining 12) - OFF		
		MAN ATT ROLL - RATE CMD	1	
	4	Perform P20 (option 2), 10.2.1		Load N78/N79 with desired PTC body vector, rate and deadband.
	5	Disable RCS & terminate P20		
		AUTO RCS (16) - OFF	8	
		RHC PWR DIR (2) - OFF (verify)	1	
CP		V56E	2,140	Terminates P20.
	6	To terminate mnvr		
AC		CMC MODE - FREE	1	
		AUTO RCS - as desired	8	
CP		Verify P00	2,140	
AC		CMC MODE - AUTO (verify)	1	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.2.6 Orb Rate (P20 option 2)		Provides orb rate maneuver by implementing P20 rotation (option 2). Also refer to 6.1.3, note 3r.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1 CMC ATT - IMU (verify) .05 G sw - OFF (verify) LOGIC 2/3 PWR - on (up)		Provides display and SCS control capability. If SCS - on option not selected.
AC	1	RHC (2) - LOCKED FDAI SCALE - 5/1		
	2	Mnvr to orb rate att Perform V49 (R62), 8.3.4		
		When att satisfactory Damp vehicle rates		Final ENTR in V49.
		Sel single jet (roll) compatible with DAP load		
	3	Configure RCS jets AUTO RCS - as desired MAN ATT (3) - RATE CMD	8 1	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	→	Perform P20 (option 2), 10.2.1		Load N78/N79 with desired orb rate body vector, r te and deadband.
	5	To terminate mnvr RHC - out of detent		
CP		or V56E	2,140	Terminates P20.
		or Key V37E 00E		
AC		or SC CONT - SCS	1	

ORB RATE (P20 OPTION 2)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.3 EXTENDED VERBS		
		8.3.1 (V35) DSKY Condition Light Test		Procedure designed to test CMC/caution and warning, DSKY interface.
		CMC - on (req), 8.1.3		
CP	1	Key V37E 00E (req)	2,140	Must be performed while in P00.
	2	Key V35E		
	3	Monitor the following events		
		a. All DSKY condition lts - on		
		b. ISS warning lt - on CMC warning lt - on MASTER ALARM lt - on		CMC lt on allows PIPAs to drift, generates alarm 00212 and may cause PIPA bias shift.
		c. All DSKY numerical windows disp 8 Sign positions in R1, R2, R3 show + V, N windows flash		
		Wait 5 sec		
		d. All DSKY warning lts - out (except PROG lt, if IMU on)		NO ATT will be left on if coarse align occurring. PROG lt remains on for ≈10 seconds.
		e. ISS lt - out CMC lt - out Reset MASTER ALARM lt		
		f. DSKY - P00 Interrupted disp (if any) will be restarted		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	g.	Wait 10 sec		Because V35E removes power to PIPAs, 10 seconds should be allowed after V35 completion before the PIPAs are used.
		Key RSET		Unless in R3, clears fail registers of 00212 (PIPA fail) alarm.
	8.3.2	(V42) Torque Gyros		Fine aligns stable member by torquing gyros (primarily for ground use).
		CMC - on (req), 8.1.3 ISS - on (req) & orient known (desired), 8.1.3 & sec 13		
	1	Key V37E 00E	2,140	
	2	For Load <100° Key V42E		
		Poss OPR ERR		If another extended verb active.
	or	For Load >99.999° Key V21 N02E 2757E XXXXXE N15E XXXXXEE YYYYYEE YYYYYEE ZZZZZEE ZZZZZE Key V42E		Load >90 deg should not be performed during flight.
		Poss OPR ERR		If another extended verb active.
	3	FL V21 N93 (request load)		If SC CONT at CMC and CMC MODE at AUTO or HOLD, DAP will maneuver vehicle to follow the platform as it moves.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Δ Gyro X, Y, Z XX.XXX DEG	2,140	Registers initially blank.
	Accept Load desired data DSKY displays V42 NO ATT lt - out		
	Reject V33E DSKY displays V42 NO ATT lt - out		Key V33E if gyro torquing registers loaded prior to keying V42E. Also refer to 6.1.3, note 3m.
	Poss OPR ERR		If IMU stall routine in use.
	8.3.3 (V43) Load FDAI Error Needles		Loads crew specified angles into FDAI error needles (primarily for ground use).
	CMC - on (req), 8.1.3 ISS - on (req), 8.1.3 RCS DAP - off		Prevents undesirable jet firing.
1	Key V37E 00E		V43E can be executed only from P00.
2	Key V43E		
	Poss OPR ERR		V43E cannot be executed if CMC not in P00, IMU in coarse align or zero ICDU mode, or if another extended verb active. (Latter is constraint after liftoff.)
3	FL V21 N22 (request load) R, P, Y XXX.XX DEG		Registers initially blank.
	Load desired err angles		Maximum effective angle which may be loaded is ±16.88 degrees.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.3.4 (V49) CSM Crew Defined Maneuver (R62)		Provides method of performing CMC controlled maneuver to crew defined attitude.
		CMC - on (req), 8.1.3 ISS - on (req) & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2		
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
CP	1	Key V37E 00E	2,140	Routine R62 may be called from P00 only.
	2	Sel Tot Att (ISS) Disp, 7.2.5		Both FDAIs recommended so either reference system (IMU or GDC) may be monitored. (CMC attitude error and rate displays available.)
	3	Key V49E Poss OPR ERR		 If another extended verb active.
	4	FL V06 N22 (fnl gmbl angles) R, P, Y XXX.XX DEG Accept PRO Reject V25E load desired gmbl angles		
		(R60 - Attitude Maneuver Routine)		Provides for maneuver (automatically or manually) to specified attitude.
	5	FL V50 N18 (auto mnvr request) R, P, Y XXX.XX DEG		Required gimbal angles.

STA/T STEP		PROCEDURE	PANEL	REMARKS
AC	Accept	BMAG MODE (3) - RATE 2	1	
		Sel CMC Att Cont Auto, 7.1.6		
CP		PRO	2,140	May be performed second time as attitude trim.
		V06 N18 (auto mnvr)		Non-flashing display until completion of auto maneuver then returns to FL V50 N18. Maneuver rates will be as specified by last DAP data load (R03/R04).
		R, P, Y XXX.XX DEG		
		Monitor auto mnvr on FDAI		
		Recycle 5		
	Reject	Key V62E		Selects Mode 2, total attitude error on FDAI needles.
		RHC - Null FDAI needles		Any input from RHC (RHC out of detent) will be interpreted by CMC as a manual override and will cause immediate termination of auto maneuver calculation and return to FL V50 N18.
		When att satisfactory		
		ENTR		Exit R60/R62.
		8.3.5 (V57) Full Track Flag Specification		Displays status of full track flag (FULTKFLG), and allows change by DSKY entry. Flag is examined only during auto W-matrix reinitialization following TPI (MINKEY) rendezvous sequence (TPIMNFLG set). FULTKFLG indicates whether full track (VHF and optics marks), or partial track (VHF or optics marks) will be used to update the state vector.
		CMC - on (req), 8.1.3		
		1 Key V57E		
		Poss OPR ERR		If another extended verb active.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V04 N12 00004 (full track option) 0000X X = 1 (partial track) X = 0 (full track) Accept PRO (exit) Reject Key V22E Load desired option If priority disp appears after N12 load Key V32E FL V04 N12 PRO (exit)	2,140	R2, current status of FULTKFLG. P20, VHF or optics marks (FULTKFLG set). P20, VHF and optics marks (FULTKFLG reset). Ensures desired flag setting. Get third N12 display.
		8.3.6 (V64) Optics Angles Transform (R64) CMC - on (req), 8.1.3		Displays the tracking angles corresponding to given optics angles, and automatically alters spacecraft tracking axis (as contained in N78) since R61 constructs the tracking vector from the contents of N78.
	1	Key V64E Poss OPR ERR Exit R64		If another extended verb in process.
	2	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG		

(V64) OPTICS ANGLES TRANSFORM (R64)

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO	2,140	
	Reject Key V24E		
	Load desired data		
3	FL V06 N78		If P20 active when this routine performed, the values displayed in N78 may be used for tracking. Each time MINKEY is initiated, N78 R1 and R2 will be overwritten.
	Y	XXX.XX DEG	P20 yaw angle (gamma).
	P	XXX.XX DEG	P20 pitch angle (rho).
	Az	XXX.XX DEG	
	Accept PRO		
	Reject Key V25E		
	Load desired data		
4	Return to prog in progress		
8.3.7	(V67) Start W-Matrix RSS Error Display		Provides display of RSS position and velocity errors, and opportunity to load new initialization values. However, initialization will not take place until next opportunity.
	CMC - on (req), 8.1.3		
1	Key V67E		
	Poss OPP EPR		If another extended verb in process.
	Exit		
2	FL V06 N99		
	POS ERR	XXXXX. FT	RSS value of position error.
	VEL ERR	XXXX.X FPS	RSS value of velocity error.

STA/T STEP	PROCEDURE		PANEL	REMARKS
CP	Option code	0000X	2,140	Option code: (initially 00000) 00000 - No initialization 00001 - RNDZ W-matrix reinitialization.
	Accept PRO			Bypasses reinitialization, if R3 = 00000.
	Reject Key V25E			R3 must contain 00001 to allow initialization.
	Load desired data (per following tables)			To initialize at new values. Initialization occurs next time a measurement is made. V93E required to enable r/v W-matrix initialization.
	Key V93E			

W-MATRIX TABLE (V67)

WRENDPOS		2000-P20	WRENDVEL		2001-P20
N99 R1	1000 ft	OCT	N99 R2	fps	OCT
10000	10	137	10	10	762
08000	8	114	8	8	620
06000	6	71	6	6	453
04000	4	46	4	4	307
02000	2	23	2	2	144
01000	1	11	1	1	61
00800	.8	7	.8	.8	50
00600	.6	5	.6	.6	34
00400	.4	3	.4	.4	24
00300	.2	2	.2	.2	10
00100	.1	1	.1	.1	5

N99 values to be loaded to obtain desired POS ERR and VEL ERR elements with corresponding octal values for erasable.

(V67) START W-MATRIX RSS ERROR DISPLAY

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.3.8 (V74) Initialize Erasable Dump Via Downlink		Dumps all eight banks of erasable memory via downlink.
		CMC - on (req), 8.1.3		
CP	1	Key V74E (V74 will deliver two complete dumps)	2,140	
		8.3.9 (V91) Display Banksum		Displays sum of each bank for comparison.
		CMC - on (req), 8.1.3		
	1	Key V37E 00E		Procedure must be performed in P00.
	2	Key V91E		
		Poss OPR ERR		If another extended verb active.
	3	FL V05 N01 Banksum XXXXX Bank No. XXXXX Bugger word XXXXX		Sum of bits of chosen bank. Number of bank being read. Factor required to make |R1| = |R2|.
		Accept V34E (halt summing) Reject PRO, recycle 3 (next bank)		Expected bank and banksum acceptable (|R1| = |R2|). 43 (octal) banks (i.e., R2 = 00043 in V05 N01 display). Banks are numbered 00 to 43 (octal) corresponding to 00 to 35 (decimal) = 36 decimal banks.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.4 SCS GENERAL		
		8.4.1 SCS Power Down		Describes safe power-down configuration.
	1	Provide Safe Sys Configuration		
AC		EMS - STBY/OFF	1	
		EMS FUNC - OFF		
		EMS MODE - STBY		
		AUTO RCS (16) - OFF	8	
		BMAG MODE (3) - RATE 2	1	
		SPS THRUST - NORM		Normal position selected to prevent inadvertent SPS firing.
	2	Remove SCS Pwr		
		TVC SERVO PWR (both) - OFF	7	
		FDAI/GPI PWR - OFF		
		LOGIC 2/3 PWR - OFF		
		ELEC PWR - OFF		
		SIG CONDR/DR BIAS PWR (both) - OFF		
		BMAG PWR (both) - WARMUP		
		RHC PWR NORM (both) - OFF	1	
		xxxxxxxxxxxxxxxxxxxxx		
		For tot pwr down		6.1.2, note 7.
		BMAG 1 PWR - OFF	7	
		xxxxxxxxxxxxxxxxxxxxx		
	3	Pwr Down ORDEAL		
		FDAI sw (both) - INRTL	13	
		EARTH/LUNAR - PWR OFF		
		LTG - OFF		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	4	Pwr Down COAS		
DP		COAS PWR - OFF	15	
AC				
CP	5	Miscellaneous		
		THC - neut, LOCKED		
		RHC (both) - LOCKED		
	6	Remove Logic Sw Pwr		Optional step to place panel 1 switches on logic buses in their OFF position. Relationship between switch positions and logic buses described in 6.1.1, figure 6-3.
AC		FDAI SCALE - 5/1	1	
		FDAI SEL - 1 or 2		
		ATT SET - GDC		ATT SET switch should be left at GDC when not in use. Also refer to 6.1.1, note 6.
		MAN ATT (3) - RATE CMD		
		LIM CYCLE - on (up)		
		DBD/RATE - MAX/LO		
		ATT DBD - MAX		
		RATE - LO		
		EMS ROLL - OFF		
		.05 G sw - OFF (verify)		Remains OFF throughout mission except entry. Refer to 6.1.1, note 5. Off position powered by LOGIC 2/3 PWR - on (up).
		TVC GMBL DR (2) - 1		
	8.4.2	SCS Power Up		Used to power up display and control electronics of SCS.
	1	Provide Safe Sys Configuration		
		AUTO RCS (16) - OFF	8	
		BMAG MODE (3) - RATE 2	1	Cages BMAGs and prevents attitude error signal, if any, from causing jet firings when RCS enabled.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Set Pwr Switches		
AC		LOGIC 2/3 PWR - on (up) ELEC PWR - GDC/ECA	7	Configures G&C for future command/control functions. Provides power for control and GDC electronics.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		Switch 1 also provides SCS signal conditioner power for the following TLM functions: rate and attitude error, SCS auto TVC, MTVC, gimbal position transducer and RHC proportional rate commands. Switch 2 provides SCS signal conditioner power for TVC pitch and yaw differential clutch current TLM. For increased reliability, switches should not be set on same bus. Also refer to 6.1.2, note 5.
CP		BMAG TEMP lt (2) - out	2	
AC		FDAI/GPI PWR - OFF	7	If FDAIs are powered when BMAGs come up to speed, rate needles will oscillate full scale.
		BMAG PWR (both) - ON		Provides rate and attitude source for control and display functions.
		FDAI/GPI PWR - BOTH		Provides power for display electronics.
		RHC PWR NORM (both) - AC/DC	1	Provides power to RHC for manual control functions if needed.
	8.4.3	Drift Rate Adjust		Permits periodic adjustment of finite drift rates of <1 deg/sec. It is intended for use during long periods of drift such as in thermal control where high power consumption undesirable.
	1	Set Up Pwr Sw		
		LOGIC 2/3 PWR - on (up) ELEC PWR - ECA	7	Powers panel 1 controls for command/control functions. Powers control electronics.

DRIFT RATE ADJUST

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		BMAG TEMP lt (2) - out	2	
AC		FDAI/GPI PWR - OFF	7	If FDAIs are powered when BMAGs come up to speed, rate needles will oscillate full scale.
		BMAG 2 PWR - ON		Provides rate source for control and display functions.
		FDAI/GPI PWR - 1		Provides power for display electronics.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
		RHC PWR NORM (both) - AC/DC	1	
	2	Establish Rate Disp for Ball 1, 7.2.1		
		FDAI SEL - 1		
		BMAG MODE - RATE 2		
		.05 G sw - OFF (verify)		
	3	Establish SCS Min Imp, 7.1.2		
		MAN ATT (3) - MIN IMP		
		SC CONT - SCS		
		AUTO RCS - MNA or MNB	8	Single jet control in each axis preferred to allow fuel conservation.
	4	Adj Veh Rates		FDAI SCALE - 5/1 recommended since expected rates will be <1 deg/sec.
		RHC - ARMED		
		Adj rates using FDAI 1		
		RHC - LOCKED		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.4.4 Minimum Power SCS Attitude Hold (Three or Two Axes)		Provides attitude hold in two or three axes, as desired, for prolonged periods using low power consumption.
	1	Set Pwr Sw		
AC		LOGIC 2/3 PWR - on (up)	7	
		ELEC PWR - ECA		If total attitude display desired, select GDC/ECA.
CP		BMAG TEMP lt (2) - out	8	
AC		FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
		BMAG PWR (both) - ON		
		FDAI/GPI PWR - 1		Provides power for display electronics.
	2	Establish SCS Att Hold/Rate Cmd, 7.1.4		
		MAN ATT (3 or 2) - RATE CMD	1	Selection by axis using these switches will determine axes in which attitude hold is enabled.
		LIM CYCLE - on (up)		
		DBD/RATE - MAX/LO		
		ATT DBD - MAX		
		RATE - LO		
		SC CONT - SCS		
		BMAG MODE (3) - RATE 2		
		AUTO RCS - MNA or MNB	8	Single jet control in each axis preferred to allow fuel conservation.
		BMAG MODE (3 or 2) - ATT 1/RATE 2	1	
	3	Sel Disp, 7.2.1 & 2		
		FDAI - 1/GDC		
		FDAI SEL - 1		
		FDAI SOURCE - GDC		
		.05 G sw - OFF (verify)		

MINIMUM POWER SCS ATTITUDE HOLD

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	4	Monitor FDAI 1 att err during limit cycling		
		8.4.5 SCS Attitude Maneuver		Provides options for performing SCS attitude maneuver during normal orbital operations or to satisfy specific mission requirements. Permits easy correlation to G&C Reference Modes, sec 7, and other G&C General Procedures, sec 8.
	1	The following are req ISS - on & orient known (for step 3a), 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
	2	Obtain mnvr data from STDN		
		a. Fnl mnvr angles R___°, P___°, Y___°		
or		b. External ref cues		
	3	Maneuver		Select FDAI display as required. Also refer to 6.1.2, note 6.
		a. To specified mnvr angles If ISS avail Perform GDC align to IMU gmbl angles, 8.4.6 If ISS not avail Perform alternate SC Inertial Att Determination, 13.2.1		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Set ATT SET tw - to desired values (step 2)	1	
	Sel att cont mode, 7.1		Mode should be compatible with magnitude of maneuver - e.g., rate command, acceleration command or minimum impulse, and desired rates.
	RHC - mnvr		Use total attitude and/or attitude error displays as required to obtain final gimbal angles.
or	b. To external ref Sel att cont mode, 7.1 RHC - mnvr		Null rates at desired orientation.
	8.4.6 GDC Alignment to IMU Gimbal Angles		Provides two methods for aligning GDC to IMU.
1	The following are req CMC - (on for step 3b), 8.1.3 ISS - on & orient known, 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify) FDAI 1 sw - INRTL (desired)	13	Provides easy comparison between FDAI and ATT SET values.
2	Establish Att Cont, 7.1 Damp veh rates		Selected to prevent drift error during alignment process.
3	Perform Att Err Disp - ISS Att Set Source, 7.2.4		6.1.1, note 6.
	a. FDAI - 1/ATT SET/IMU FDAI SEL - 1	1	

GDC ALIGNMENT TO IMU GIMBAL ANGLES

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		FDAI SOURCE - ATT SET ATT SET - IMU ATT SET tw - null FDAI 1 errors	1	Verify that ATT SET tw and FDAI 1 indicate same total attitude because false nulling of error needles could occur 180° from desired attitude.
CP AC	or b.	V16 N20E ATT SET tw - adj to IMU gmbl angles on DSKY	2,140 1	
	or c.	ATT SET tw - adj to IMU gmbl angles as ind on FDAI		
	4	Align GDC, 7.3 ATT SET - GDC GDC ALIGN pb - push, hold FDAI SEL - 1/2		Verify both FDAIs indicate same total attitude.
		8.4.7 Attitude Reference System Comparison		
	1	The following are req CMC - on, 8.1.3 ISS - on and orient known, 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify)		
SPT	2	Key V37E 00E	2,140	
	3	Establish Att Cont, 7.1 Damp veh rates		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	Key V06 N20E (ICDU angles) R, P, Y XXX.XX DEG	2,140	Required to allow rough ATT SET adjustment to IMU gimbal angles prior to nulling operation. Monitor V16 may be used in lieu of display V06.
	5	Att ref comparison Select Att Err Disp, Att Set Source, 7.2.4		
AC		FDAI - 1/ATT SET/IMU FDAI SEL - 1 FDAI SOURCE - ATT SET ATT SET - IMU	1	6.1.1, note 6.
		ATT SET tw (3) - set approx to DSKY values, null FDAI 1 att errors		
CP		ENTR (when nulled)	2,140	ENTR updates display. If monitor V16 used in step 4, key VERB to freeze display.
		Record DSKY values R___°, P___°, Y___° Record ATT SET values R___°, P___°, Y___°	1	If ATT SET/GDC comparison made, error needle bias, if any, determined and may be subtracted (postflight) from GDC drift determined in ATT SET/GDC comparison.
	or	ATT SET/GDC comparison		
AC		ATT SET - GDC ATT SET tw (3) - null FDAI 1 att errors		
CP		ENTR (when nulled)	2,140	ENTR updates display. If monitor V16 used in step 4, key VERB to freeze display.
		Record DSKY values R___°, P___°, Y___° Record ATT SET values R___°, P___°, Y___°	1	

ATTITUDE REFERENCE SYSTEM COMPARISON

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.4.8 ORDEAL Initialization		Aligns one or both FDAIs to local vertical coordinates.
	1	The following are req CMC - on (for steps 4a & 7a), 8.1.3 ISS - on & aligned, nom option (for step 7a), 8.1.3 & sec 13 SCS - on, 8.4.2		IMU and/or SCS attitude reference system must be aligned with +Y axis of reference along ($\underline{V} \times \underline{R}$), where V is velocity vector and R is position vector from center of earth.
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
	2	Sel Tot Att Disp, 7.2.5		
	3	Set ORDEAL cont, 7.2.6 FDAI 2 or 1 sw - ORB RATE EARTH/LUNAR - EARTH MODE - HOLD/FAST	13	Either or both FDAIs may be driven by ORDEAL.
	4	Obtain alt setting		
CP		a. (R30) orb param disp routine Key V82E Record Ha and Hp Calculate ave	2,140	
	or	b. (P21) ground track determination prog Key V37E 21E Record alt for 10-min intervals of present orb Calculate ave		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	or	c. STDN If CMC in STBY, obtain alt setting from STDN		
AC	5	ALT SET - adj to proper alt	13	
	6	Sel att cont mode, 7.1, & mnvr to place +Xsc in orb plane (0° yaw)		
	7	Obtain θ - pitch angle to lcl horiz		θ is the angle included between +Xsc and local horizontal. Angle in range 0° to 180° indicates +Xsc above local horizontal plane. Total range 0° to 360°.
CP		a. (R31) rndz param disp routine Key V83E	2,140	
AC	or	b. STDN If CMC in STBY, obtain θ from STDN based on +Xsc pointed at horiz Mnvr to point +Xsc at horiz, 8.4.5	13	θ based on +Xsc pointed at horizon dependent on present altitude.
	8	Slew FDAI to θ		The CMC display of θ is from 0° to 360°.
	9	MODE - OPR/SLOW Slew/adj FDAI precisely		FDAI may be more accurately adjusted using 1° marks if yaw angle is 0° and roll angle 0° or 180°. When momentary SLEW switch released, ORDEAL is in operate mode.
	10	Repeat 7 thru 9 as req		FDAI sw (both) must be at INRTL (pwr OFF or not) to display pitch inertial attitude.

ORDEAL INITIALIZATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.4.9 SCS Passive Thermal Control Using Wobble Mode		For G&N Passive Thermal Control Procedure, refer to 8.1.13.
	1	Set up pwr sw		
AC		LOGIC 2/3 PWR - on (up)	7	
		ELEC PWR - ECA		If total attitude display desired, select GDC/ECA.
CP		BMAG TEMP lt (2) - out	2	
AC		FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
		BMAG PWR (both) - ON		
		FDAI/GPI PWR - 1		
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
		RHC PWR NORM (both) - AC/DC	1	
	2	Establish SCS att hold/rate cmd		
		MAN ATT (3) - RATE CMD		
		LIM CYCLE - on (up)		
		DBD/RATE - MIN/LO		This switching assumes RCS not enabled or attitude error needles are nulled before this switching performed.
		ATT DBD - MIN		
		RATE - LO		
		SC CONT - SCS		
		BMAG MODE (3) - RATE 2		
		AUTO RCS A/C ROLL or B/D ROLL (4) - MNA or MNB	8	Only one pair of roll quads should be enabled.
		AUTO RCS PITCH & YAW - set for single jet oper		Single jet control in PITCH and YAW provides reduced RCS authority for attainment of minimum rates.
		BMAG MODE (3) - ATT 1/RATE 2	1	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Select Disp		
CDR		FDAI - 1/GDC	1	
		FDAI SEL - 1		
		FDAI SOURCE - GDC		
		.05 G sw - OFF (verify)		
	4	Mnvr SC to desired att		Maneuver should place desired wobble axis in CSM -Z+Y quadrant, _____° from X axis.
	5	Achieve pitch up & yaw right rates of 0.01-0.02°/sec		Allow CSM to deadband to these rates. Rate may be obtained manually if minimum impulse control used.
	6	MAN ATT ROLL - ACCEL CMD		
		LIM CYCLE - OFF		
		DBD/RATE - MAX/HI		
		ATT DBD - MAX		
		RATE - HI		
		BMAG MODE (3) - RATE 2		
		AUTO RCS ROLL (8) - MNA or MNB	8	
		Init _____°/sec roll rate		Full roll authority can be used to establish this rate with one RHC action.
		AUTO RCS (16) - OFF		
	8.4.10	SCS Passive Thermal Control Using BAR-B-Q Minimum Power Mode		For G&N Passive Thermal Control Procedure, refer to 8.1.13
	1	Set up pwr sw		
		LOGIC 2/3 PWR - on (up)	7	
		SCS ELEC PWR - ECA		If total attitude display desired, select GDC/ECA.
SPT		BMAG TEMP lt (2) - out	2	

SCS PASSIVE THERMAL CONTROL USING BAR-B-Q MINIMUM POWER MODE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
		BMAG PWR (both) - ON FDAI/GPI PWR - 1 SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
		RHC PWR NORM (both) - AC/DC	1	
	2	Sel Disp FDAI - 1/GDC FDAI SEL - 1 FDAI SOURCE - GDC .05 G sw - OFF (verify)		
	3	Mnvr SC to desired att		
	4	Establish 2 axis SCS att hold/rate cmd MAN ATT P&Y (2) - RATE CMD MAN ATT ROLL - ACCEL CMD LIM CYCLE - on (up) or MIN IMP DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI SC CONT - SCS AUTO RCS PITCH & YAW - set for single jet oper	8	Engine combinations available for single jet control are:

SINGLE JET CONTROL				
PITCH	A3-A4	C3-C4	A3-C4	C3-A4
YAW	B3-B4	D3-D4	B3-D4	D3-B4

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		AUTO RCS A/C ROLL or B/D ROLL (4) - MNA or MNB	8	
		BMAG MODE (3) - ATT 1/RATE 2	1	
	5	Init 0.1°/sec roll rate		
	6	Mon FDAI 1 att err during limit cycling		

SCS PASSIVE THERMAL CONTROL USING BAR-B-Q MINIMUM POWER MODE

STA/T STEP	PROCEDURE	PANEL	REMARKS
	9.0 RENDEZVOUS		
	Rendezvous is accomplished by systematic performance of various navigation, alignment, targeting and thrusting programs. Manual-sequenced rendezvous is performed by manual selection of each program as it is required in the rendezvous sequence. For the MINKEY sequence, the MINKEY program automatically selects and sequences the various programs. Refer to 9.1 for manual-sequenced rendezvous and 4.9.2 for the MINKEY sequence.		
	9.1 MANUAL RENDEZVOUS SEQUENCE		
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2 Opt pwr up (req), 8.1.4		Required for target acquisition and SXT tracking during rendezvous phase.
	RCS DAP - load & activate (req), 8.2.1 Set up for VHF rng, 4.5.3		
1	Verify/confirm with STDN, oper status of Soyuz &/or CSM sys		
2	Select desired att cont, 7.1		
3	Select desired disp, 7.2		
4	Perform rndz nav, 10.2		
5	Perform targeting, 11.2		
6	Perform thrusting, sec 12		

NORMAL BACKUP

9.2 MINKEY RENDEZVOUS SEQUENCE

The MINKEY controller routine (R07) monitors and executes in proper sequence, all programs required for effecting rendezvous. P20, however, operates in the background and, unlike P31 through P38, is not displayed in the PROG lt, except for the P20 call during the NPC (P38) sequence.

MINKEY sequence is initiated by selecting the appropriate targeting program for a given point in the sequence. The sequence begins at any one of seven entry points which is determined by the targeting program selected. The seven entry points are defined as follows:

P31 (NC1)
P32 (NC2)
P33 (NCC)
P34 (NSR)
P35 (TPI)
P36 (TPM)
P37 (TPF)

To enter the MINKEY sequence before NC1 (Normal Corrective Mnvr #1), P31 is selected; to enter before NC2, P32 is selected, etc. The MINKEY controller will, from entry point selected, automatically sequence the required programs. As with other CMC programs, the operator must accept or reject data, or provide desired data to the CMC to have the programs sequence properly.

9.2.1 MINKEY Operating Notes

The MINKEY process minimizes a number of calculations, loading of data, and certain operator decision requirements. Some of these features and other data pertinent to MINKEY are defined in the following MINKEY operating notes.

1. An erasable quantity designating desired attitude for performing rendezvous is preloaded. According to this value, the CMC computes and executes the appropriate attitude maneuvers.

2. Calculations for out-of-plane corrections are automatically performed, displayed, and scheduled for the appropriate maneuver.

3. The CMC reinitializes the W-matrix according to predetermined data requiring no operator consideration.

4. VHF range data are automatically collected and processed continuously in R22 when enabled by V87E (terminated by V88E), and in R22 (via R27) when enabled by V76E (terminated by V77E). When called by R22, VHF measured range is extended beyond 327.67 NM if indicated by the range computed in R61 using on-board state vector estimates.

5. SXT data (marks) can be taken at any flashing display when P20 is running (extended verb not required).

6. P52 provides option for gyro torquing ($\pm 45°$ depending on state of TCOMPFLG) prior to NPC maneuver and if torqued, returned to original alignment after burn. Provides more suitable platform orientation for the thrusting maneuver.

7. The NPC sequence (P38) can only be entered via V37E 38E. It is not automatically called, in line, by the MINKEY controller.

8. Providing REFSMFLG set, keying in any one of the targeting programs, P31 through P38, causes an immediate display of FL V50 N25, R1 = 00017 (request MINKEY). A PRO response initiates automatic sequencing. ENTR inhibits automatic and allows manual sequencing.

9. For both PRO and ENTR to FL V50 N25 (R1 = 00017), R61/R60 is selected to execute maneuver to tracking attitude via P20. By holding at any flashing display, optics (SXT) marks or COAS marks (V54E), can be taken anytime P20 is running (after maneuver to track attitude), or VHF ranging marks may be allowed to accumulate provided VHF ranging has been enabled (refer to note 4).

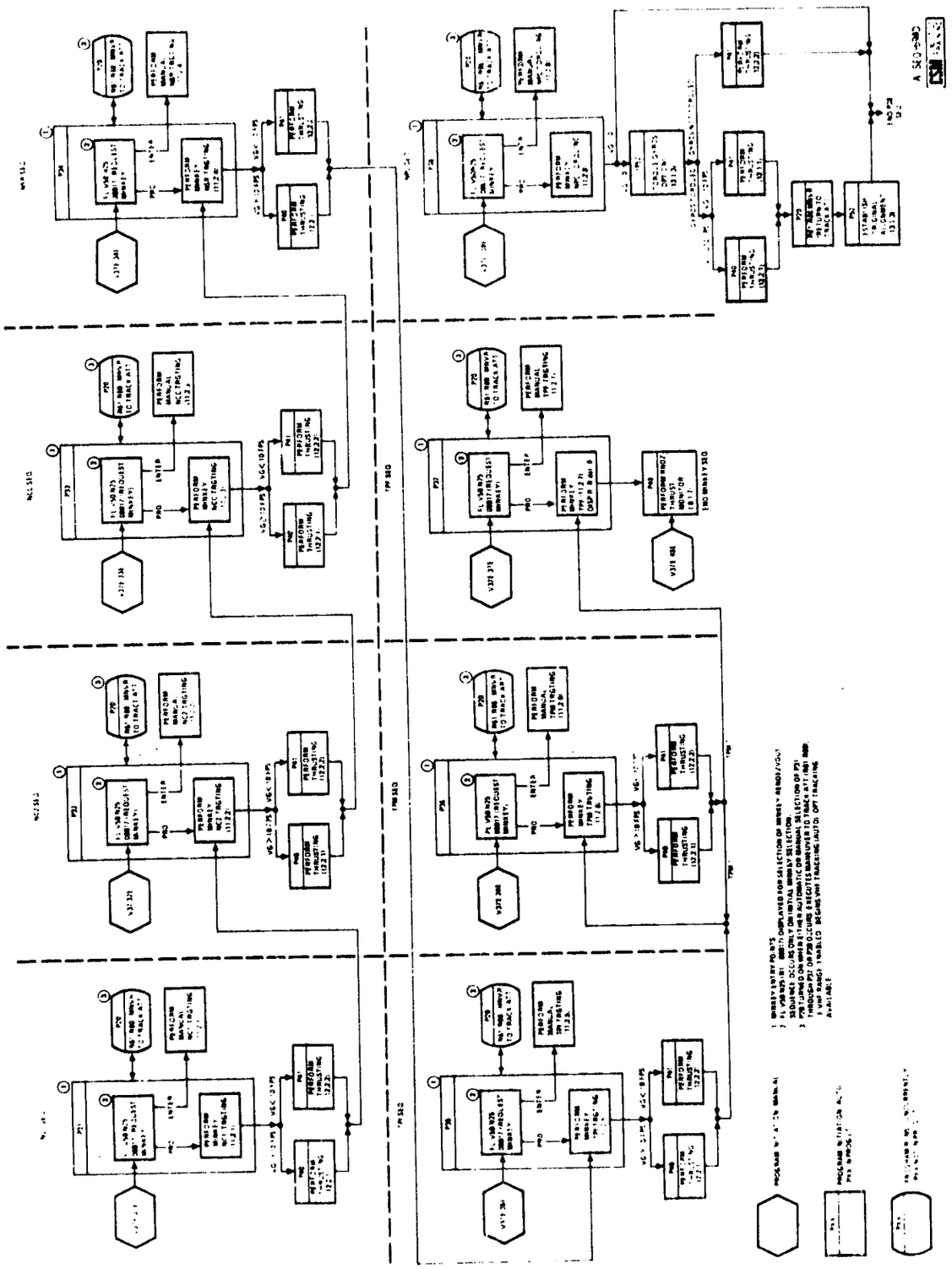
10. For P20 (options 0, 1, 4, 5), as applied to R61/R60 (maneuver to track attitude), the 10° criterion is pointing error measured as angle between the LOS and center of DAP deadband.

9.2.2 MINKEY Rendezvous Sequence (Flow)

Following is a simplified flow diagram of the MINKEY rendezvous sequence. The diagram summarizes the sequence of events as they would occur from any one of the entry points into the MINKEY sequence (i.e., selection of P31, P32, etc.). Each program, as it is called by the MINKEY controller, is completed in the usual manner, even though, as previously stated, certain additional functions are performed by the CMC, thus minimizing the need for operator actions otherwise needed for program completion.

MINKEY RENDEZVOUS SEQUENCE

NORMAL BACKUP



MINKEY RENDEZVOUS SEQUENCE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.0 NAVIGATION		For general G&C operating data, refer to operating notes, 6.1.
		10.1 ORBITAL NAVIGATION		
		10.1.1 (P21) Ground Track Determination		Provides crew ground track data for either CSM or Soyuz, based on time loaded in 3.
		CMC - on (req), 8.1.3		
CP	1	Key V37E 21E	2,140	
	2	FL V04 N06		
		Option code 00002		
		CMC assumed option 00001 (00001 = CSM, 00002 = Soyuz)		CMC initializes R2 to 00001.
		Accept PRO		
		Reject V22E (load desired option)		
	3	FL V06 N34		Initial display will contain zeros (present time). If not changed by astronaut, P21 calculations will be based on present time.
		GET lat long 00XXX. HRS 00XX. MIN 0XX.XX SEC		GET at desired position of selected vehicle.
		Accept PRO		State vector integrated forward to desired time.
		Reject V25E (load desired T-lat long)		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	4	FL V06 N43		2,140	
		Lat (+N)	XXX.XX DEG		Selected vehicle latitude at T-lat long.
		Long (+E)	XXX.XX DEG		Selected vehicle longitude at T-lat long.
		Alt	XXXX.X NM		Selected vehicle altitude above launch pad radius at T-lat long.
		If desired			
		Key N73E			
		Alt/10	XXXXX. NM		
		VI	XXXXX. FPS		
		Gamma	XXX.XX DEG		
		To increment T-lat long by 10 min			
		Key V32E			For V32E, program keeps previous state vector for use in starting next iteration without, however, ensuring that subsequent integrations are precision. If times reasonably close, V32E should be used; if far apart, would be quicker to reselect P21.
		Return to 3			
	5	PRO (term P21)			R00.
		FL V37			
		Key XXE			

(P21) GROUND TRACK DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	10.1.2 (P29) Time of Longitude		Provides time of (CSM or Soyuz) first crossing of a specified longitude after a specified time.
	CMC - on (req), 8.1.3		
CP	1 Key V37E 29E	2,140	
	2 FL V04 N06		
	Option code 00002 CMC assumed option 00001 (00001 = CSM, 00002 = Soyuz)		CMC initializes R2 to 00001.
	Accept PRO Reject V22E (load desired option)		
	3 FL V06 N34		Initial display will contain zeros (present time). If not changed by astronaut, P29 calculations will be based on present time.
	GET base time 00XXX. HRS 000XX. MIN 0XX.XX SEC		Base time from which next crossing of desired longitude is computed.
	Accept PRO Reject V25E (load desired base time)		State vector integrated forward to desired base time.
	4 FL V06 N43 R2 Long (desired) XXX.XX DEG		

STA/T STEP	PROCEDURE		PANEL	REMARKS
CP	Accept PRO Reject V22E (load long)		2,140	CMC computes time of next crossing of desired longitude after base time.
5	FL V06 N34 GET long	OOXXX. HRS OOOXX. MIN OXX.XX SEC		Time of longitude crossing.
	Accept PRO Reject V32E, return to 4			To re-specify longitude using original base time.
6	FL V06 N43 Lat (+N) Long (+E) Alt	XXX.XX DEG XXX.XX DEG XXXX.X NM		Latitude, longitude, altitude at crossing.
	Accept PRO (Term P29) Reject V32E, return to 2			To re-specify input data.
7	FL V37 Key XXE			

(P29) TIME OF LONGITUDE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.1.3 (V82) Orbit Parameter Display (R30)		Provides crew with CMC computed orbital parameters. Time from perigee (TF perigee) available via N32 if Hp >49.4 NM (300,000 feet). If P00 or P11 running, ΔR (miss distance) available via N50.
		CMC - on (req), 8.1.3		
CP	1	Key V82E If ave G routine on, go to 4	2,140	
	2	FL V04 N12 Option code 00002 CMC assumed option 0000X (1 = CSM 2 = Soyuz) Accept PRO Reject V22E (load desired option)		
	3	FL V06 N16 GET event 00XXX. HRS 000XX. MIN 0XX.XX SEC Accept PRO Reject Key V25E Load desired time		Time for state vector integration. TFF (N50) and time from perigee (N32) continue to be measured from present time rather than N16 input time. CMC sets time option initially to zero, meaning present time.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	FL V16 N44	2,140	If average G on, display updates every 2 seconds.
		Ha XXXX.X NM Hp XXXX.X NM		Above launch pad radius. Calculations are subject to limitations of two-body approximation and yield reasonable results if vehicle close to earth.
		TFF XXBXX MIN-SEC		Time of free fall to 49.4 NM (300,000 feet). TFF reads -59B59 if Hp >49.4 NM; under these conditions, time from perigee available by keying N32. If average G off and Hp <49.4 NM, TFF counts down. For N32, if average G off and Hp >49.4 NM, time from perigee counts down.
		Accept PRO Reject V32E Recycle to 3		Recalculates orbital parameters. (Valid only if average G off.)

(V82) ORBIT PARAMETER DISPLAY (R30)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	10.2 RENDEZVOUS NAVIGATION		
	10.2.1 (P20) Universal Tracking & Rendezvous Navigation		Purpose: • Rendezvous - Performs normal rendezvous navigation, attitude control, and optics pointing. • Rotation - To produce a rotation about a specified SC body vector. • Universal tracking - To point (and maintain) a specified SC vector at a specified celestial body. Crew may exercise control of P20 functions via response to N06, N78, N79 and through use of the following extended verbs. V76E - Enables R27 in R22. V77E - Disables R27 in R22. V80E - Selects Soyuz state vector update. V81E - Selects CSM state vector update. V87E - Allow R22 to accept VHF range data. V88E - Inhibit acceptance of VHF range data. Program can be selected manually (V37E 20E), or automatically by MINKEY controller. Refer to 9.2 for additional data on MINKEY rendezvous sequence.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 Opt pwr up (req), 8.1.4		Provides total attitude and rate monitoring. Not required for VHF update.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		VHF AM ranging mode sel (req), 5.6.3		Not required for optical update.
AC		CMC ATT - IMU (verify)	1	
		LOGIC 2/3 PWR - on (up) (if no SCS)	7	Required for control and display functions.

Programs Allowing P20 in Background	P20 Option 0	1	2	4	5
21**	X	X	X	X	X
27*		X	X		X
29**	X	X	X	X	X
30	X	X	X	X	X
31	X			X	
32	X			X	
33	X			X	
34	X			X	
35	X			X	
36	X			X	
37	X			X	
38	X			X	
52*			X		
54*			X		

*UTFLAG set
**Tracking only (no navigation)

CP	Key V93E (if necessary)	2,140	If one hour or more has elapsed since W-matrix initialization or if state vector has not been updated via P27.
	Sel Tot Att disp, 7.2.5		
	Sel Att Cont mode, 7.1		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	1	Key V37E 20E	2,140	Manual selection of P20 (option zero automatically set). Other options available in step 2.
	or	If P31 through P38 sel P20 - on (auto) (P20 functions defined in each trgting prog)		MINKEY selection. If IMU on and aligned, P20 turned on automatically if programs P31 through P38 selected. This occurs whether or not rendezvous to be accomplished by MINKEY sequencing. P20 called to accomplish maneuver to tracking attitude, and various navigation tasks including VHF and optics tracking. No P20 displays are provided except FL V50 N18 in R60.
		Poss PROG alarm (4.8.1.16)		R02. (8.1.15)
	2	FL V04 N06 00024 (P20 option) 0000X		R2 initialized zero. If option zero desired, there is no choice but to use manual rendezvous sequence. If option 4 desired, either manual or MINKEY sequencing may be used. MINKEY, however, can only be performed using option 4. When a targeting program, P31 through P38 is called, option zero is automatically set. If not previously selected, P20 (option 4) will be automatically selected when MINKEY first initiated (PRO on FL V50 N25, R1 = 17).
		(X = 0, 1, 2, 4, 5)		P20 options defined as follows: 0 - Soyuz tracking (VECPOINT). Point specified SC vector at Soyuz (no attitude constraint about pointing vector). After initial selection, new SC vector can be chosen without reselecting P20. P20 initializes N78 to preferred track attitude (0°, -35°, 0°).

NORMAL BACKUP

STA/T STEP		PROCEDURE	PANEL	REMARKS
CP	Accept Reject	PRO Key V22E Load desired option	2,140	1 - Celestial body tracking (VECPOINT). Point specified SC vector at celestial body (no attitude constraint about pointing vector). After initial selection, new SC vector can be chosen without reselecting P20. However, P20 must be reselected to change target (celestial body) code (N70/N88). If P20 in foreground (PROG lt = 20), P00 type integration will occur and P27 may be selected. 2 - Rotation. Rotate about a specified SC vector. Current contents of N78 and N79 used only when rotation begins by P20 initiation, by V58E after RHC deflection, or by V37 to a tracking program following a program not allowing rotation. If P20 in foreground (PROG lt = 20), P00 type integration will occur and P27 may be selected. Refer to 8.2.5 and 8.2.6 for PTC and orb rate procedures using option 2. 4 - Soyuz tracking (3 axis). Point specified SC vector at Soyuz (hold attitude about pointing vector). After initial selection, new SC vector or azimuth constraint can be chosen without reselecting P20. P20 initializes N78 to preferred track attitude (0°, -35°, 0°). 5 - Celestial body tracking (3-axis). Point specified SC vector at celestial body (hold attitude about pointing vector). After initial selection, ...continued

STA/T STEP	PROCEDURE	PANEL	REMARKS
			new SC vector or azimuth constraint can be chosen without reselecting P20. However, P20 must be reselected to change target (celestial body) code (N70/N88). If P20 in foreground (PROG lt = 20), P00 type integration will occur and P27 may be selected. For R2, a value of X = 3, 6 or 7 will be treated as X = 2. (Options 0, 1, 4, 5) If CMC/FREE or SCS control modes selected during these P20 options, desired attitude is computed but test for R60 is never made and, therefore, neither UPLINK ACTY lt nor FL V50 N18 will appear if attitude deviation unacceptable. Monitor mode II (V62E) FDAI attitude error needles when in SCS or CMC/FREE modes.
CP 3	FL V06 N78 (SC vctr angles) Y, P, az XXX.XX DEG Accept PRO Reject Key V25E Load desired data If presently rotating & new N78 contents to be used PHC - move from detent Key V58E If P47 previously sel during P20 Reload N78	2,140	All options. Program initializes N78 with values of preferred tracking attitude (0°, -35°, 0°) only if options 0 or 4 chosen. R1 & R2 (Y & P) are used to specify desired SC body vector to be pointed. The combination of P = 0° and Y = ±90° is a constraint upon options 4 and 5 and should not be specified. Azimuth (R3) used only by options 4 and 5 to hold attitude about a specified SC vector. When MINKEY first initiated R3 automatically loaded to 000.00° if HDSUPFLG set, or +180.00° if HDSUPFLG reset. Selection of P47 during P20 destroys least significant half of N78 (R1); will cause incorrect N78 (R1 data) and may cause bad tracking or rotation.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	FL V06 N79	2,140	All options.
		Rate X.XXXX DEG/SEC DBD XXX.XX DEG		If option 2, R1 & R2 displayed; for options 0, 1, 4 & 5, R2 only displayed. R2 initialized to current DAP deadband. Zero input causes 0.5° deadband to be employed. Maneuver rates for other than option 2 will be those computed as necessary to track the target.
		Reject Key V21E, V22E, V24E Load desired data Accept PRO Options 0 & 4, go to 8* 1 & 5, go to 5 2, go to 7		
		If presently rotating & new N79 contents to be used RHC - move from detent		Stops rotation, allows initialization to new N79 values.
AC		or SC cont - CMC/HOLD	1	
		SC CONT - CMC CMC MODE - HOLD		
		CMC MODE - FREE (verify) Load new data		Prevents collapsing desired deadband.
CP		Key V58E	2,140	
AC		CMC MODE - AUTO	1	Resumes rotation with new N79 values.
CP	5	FL V01 N70	2,140	Options 1 & 5. Celestial body to be pointed at. No specific values preloaded.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		Trgt code	00CDE	2,140	Target codes: [In P20, source code (C) must be zero. Any non-zero digit turns on OPR ERR lt] 00 - Planet (any planet except earth) 01 to 45 - Star 46 - Sun 47 - Earth
		Reject Key V21E Load trgt code			
		Accept PRO R1 = 00, go to 6 R1 >00 & ≤47, go to 8			
		Poss OPR ERR Recycles disp			Target code negative or >47.
	6	FL V06 N88 (planet only)		2,140	Options 1 & 5 (if N70 = 00). No specific values preloaded.
		X, Y, Z	.XXXXX		Components of planet unit position vector at present time.
		Accept PRO, go to 8 Reject Key V25E Load desired data			Use on-board tables to determine planet position vector at present time.
	7	FL V06 N34			
		Time of event	00XXX. HRS 000XX. MIN 0XX.XX SEC		Option 2. Time to begin rotation. No specific time preloaded.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO		1	Schedules rotation about specified SC vector to begin at specified time (immediately if time in past).
CP		PRO		2,140	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		(R67, Rotation Maneuver Routine)		Option 2 - Provides capability of having DAP maintain a controlled rotational rate about a specified SC vector. Refer to 8.2.4 & 5 for orb rate/PTC (P20 option 2) procedures. Remaining P20 procedure does not apply to option 2.
		Begin rotation (PRO on N34)		
		To stop rotation RHC - move from detent		Establishes attitude hold.
AC		or SC cont - CMC/HOLD SC CONT - CMC CMC MODE - HOLD	1	
		To re-initiate rotation Key V58E	2,140	Re-establishes rotation to N78/N79 data (original or new data loaded).
		To terminate mnvr Key V56E		Terminates P20 and all options.
		or Key V37E 00E		
		(R61, Tracking Attitude Routine)		Computes required gimbal angles at tracking attitude with present IMU orientation, extrapolates (periodically) CSM and Soyuz state vectors to present time and calculates LOS from CSM to Soyuz. Maneuver is performed so as to yield a minimum attitude maneuver.
	8	Maneuver		9.2.1, note 10.
AC		If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Options 0 or 4, go to 10 Option 1 or 5, exit (R61 maintains track att)	1	If maneuver <10°, R61 performs maneuver to tracking attitude. R61 will continue to compute and maintain selected attitude (option) as long as SC cont - CMC/AUTO and RHC not moved out of detent. For maneuver <10°, remainder of P20 procedure does not apply to options 1 and 5.

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	If mnvr ≥10°, go to 9		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY lt.
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive) Key V23 N78E Change N78 (R3) KEY REL		Options 4 and 5. Load value in R3 to reduce MGA to acceptable limit.
	If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E		Prevents maneuver into gimbal lock. Sets V50N18 flag.
	If mnvr <10° Option 0 or 4, go to 10 Option 1 or 5, exit (R61 maintains track att)		
	If mnvr ≥10°, go to 9		
	or Align IMU to acceptable orient, sec 13		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60, Attitude Maneuver Routine)		Maneuvers (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
CP		(If UPLINK ACTY lt on Key V58E)	2,140	Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	9	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified SC vector in direction of LOS to specified target.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
		Reject Key V62E RHC - null FDAI err needles Recycle 9		Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	PRO Recycle 9	2,140	
	When att satisfactory ENTR		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation requested, and optimized VHF range and range rate may be obtained by enabling R27 (step 16).
	Options 0 or 4 a. If opt sighting mrks desired, go to 10 or b. If BU opt (COAS) sighting mrks desired, go to 12 or c. If VHF ranging update desired, Key V87E, go to 15		Remainder of procedure applies to options 0 and 4 only.
	(R52, Automatic Optics Positioning)		(Options 0 or 4). Points star LOS of optics at Soyuz during rendezvous tracking operations. Cycles R61 approximately every 2 seconds during rendezvous tracking operations (maintains tracking attitude).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	10	OPT ZERO - ZERO OPT MODE - CMC	122	6.1.3, note 4g.
		If TA >50° (options 0 & 4)		Trunnion driven to upper limit (≈49.7754°) and held at this angle.
AC		RHC - mnvr to reduce TA		Key V16 N22E for desired gimbal angles.
	or	SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
		If RHC moved from detent		
CP		Key V58E	2,140	
	11	OPT MODE - MAN OHC - ctr trgt in SXT MARK pb - push	122	Required for centering target using OHC.
		Accept Repeat mrk proced		If more marks desired. If any mark results in excessive update, priority display FL V06 N49, step 15, will interrupt program and display magnitude of excessive update.
		or OPT MODE - CMC Go to 15		If sufficient marks have been made.
		Reject MARK REJ pb - push		Should be done promptly (within 7 seconds) to ensure mark has not been processed.
		Repeat mrk proced		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 00121 (att rate >two-thirds deg/sec)	2,140	Sighting marks automatically rejected.
	(R23, Backup Rendezvous Tracking Sighting Mark Routine)		(Options 0 & 4). To perform sighting marks on Soyuz using backup optics (COAS).
12	Key V54E		
13	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG Accept PRO Reject Key V24E Load desired data		Values obtained from COAS calibration, 13.1.8 Nominal SA and TA for COAS sightings are: SA - 000.00 DEG TA - 57.470 DEG
14	FL V53 N45 (request alt LOS mrk) Mrks (VHF/opt) XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken any time P20 operating (after maneuver to sighting attitude).

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	TF GETI (next burn) XXBXX MIN-SEC	2,140	Contents dependent on external programs. If P20 only, display static. Constraint - R2 cannot be >59B59 at this point. If TF GETI >59 min 59 sec, display is limited. N35 may be used to get full time to ignition.
	MGA (next burn) XXX.XX DEG		Contents dependent on external programs. If P20 only, display static.
	RHC - align Soyuz in COAS ENTR		Alternate LOS mark.
	Accept Repeat mrk proced		If more marks desired.
	or Wait 15 sec		To allow processing of final mark.
	PRO		If sufficient marks have been made. To ensure processing of last mark, wait 15 seconds before proceeding. This allows for previous marks to be processed. If PRO done too soon, last mark may be treated as a prime rather than a backup mark.
	Reject V86E Repeat mrk proced		Rejects previous mark. Should be done promptly (within 7 seconds) to ensure mark has not been processed.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	(R22, Rendezvous Tracking Data Processing Routine)		(Options 0 & 4). Processes optics and VHF ranging data in accordance with status of FULTKFLG and integrates CSM and Soyuz state vectors to present time. Nominally, CSM state vector is automatically selected for incorporation by initial entry to P20. V80 and V81, however, are also available for selecting Soyuz and CSM state vecto update respectively. For FULTKFLG status, or change, refer to 8.3.5.
CP 15	Poss FL V06 N49 (2 sec priority) ΔR XXX.XX NM ΔV XXXX.X FPS Source code 0000X.	2,140	Excessive update parameters. To change ΔR and ΔV threshold values, refer to 8.1.10. 00001 = Optics (CMC does not differentiate between SXT and COAS marks). 00002 = VHF ranging. For this option, refer to 5.6.3.
	Wait 2 sec		Priority display. Will not respond to DSKY input until after 2 seconds.
	Accept PRO Reject Key V32E		Incorporates update data. Does not incorporate update data.
	(R27, VHF Range/Range Rate)		Provides method of obtaining optimized measurements of VHF range and range rate, and ϕ, either for present time or for a desired time specified via N72. The time interval for optimizing range rate should be chosen so as not to conflict with final computations for a targeting solution. Targeting solutions should be obtained after recording optimized results in N77.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	16	Key V76E	2,140	Enables R27 in R22.
		Poss OPR ERR Exit		If another extended verb active.
	17	FL V06 N72 T (R27 optimized) 00XXX. HRS 000XX. MIN 0XX.XX SEC Accept PRO Reject Key V25E Load GET for optimization		
	18	Obtain current R & R dot Key V16 N76E R XXX.XX NM R dot XXXX.X FPS TFO (- closing) XXBXX MIN-SEC		Range. Range rate. Time from R27 optimization(counting to N72 time).
	19	Monitor R3 → 0 Center Soyuz in opt FOV With Soyuz centered and R3 = 0 MARK		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	20	Obtain optimized values of R, R dot & ϕ		
		Key N77E	2,140	Displays latest optimized range and range rate.
		R XXX.XX NM		
		R dot (- closing) XXXX.X FPS		
		ϕ XXX.XX DEG		ϕ computed for last N72 time.
		Record N77 data		
		V77E		Disables R27 in R22.
		Go to trgting prog		
	21	To term P20 & all other prog running		6.1.3, note 3r.
		Key V37E 00E		
	or	To term P20 only		
		Key V56E		If V56E keyed in during computation in P35/P36, these computations will be restarted from beginning.
		Poss FL V37		FL V37 only if no other program active.
		Key XXE		
	22	Set opt cont		
		OPT ZERO - ZERO	122	
		OPT PWR - OFF	100	
		RETCL BRT tw - DIM	122	

STA/T	STEP	PROCEDURE		PANEL	REMARKS
		10.2.2 (P25) Contingency VHF Range Rate			Displays range and range rate from a source independent of vehicle state vectors. Allows selection of a time at which range rate will be optimized.
		CMC - on (req), 8.1.3 VHF AM ranging mode sel (req), 5.6.3			
CP	1	Key V37E 25E		2,140	
	2	FL V06 N72			
		T (R27 optimized)	00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept PRO Reject Key V25E Load desired data			No R27 optimization if zeros loaded in N72.
		If N72 = 0, go to 4			
	3	FL V16 N76			
		R	XXX.XX NM		Range (updated at a 2-second interval).
		R dot (-closing)	XXXX.X FPS		Range rate. Updated at 2-second interval.
		TFO	XXBXX MIN SEC		Time from R27 optimization updated at 1-second interval (59B59 = no R27 optimization).
		Accept PRO Reject Key V32E Return to 2			To respecify additional optimization time.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	4	FL V16 N77		2,140	If N72 = 0 R, R dot = current values If N72 ≠ 0 TFO < -01B35, R, R dot = current values -01B35 < TFO < +00B02, R, R dot fixed at last current value +00B02 < TFO < +01B35, R, R dot = optimizing values. TFO > +01B35, R, R dot = optimized values New optimization is done every 4 minutes.
		R	XXX.XX NM		
		R dot (-closing)	XXXX.X FPS		
		θ/ϕ	-00001 code		
		Accept	PRO		To optimize R dot for new N72 time.
		Reject	Key V32E Return to 2		
	5	FL V37 Key XXE			

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.3 (V83) Rendezvous Parameter Display #1 (R31)		Displays CMC calculated rendezvous parameters (range, range rate, and theta).
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13		Required for meaningful display of theta.
CP	1	Key V83E	2,140	V83 automatically executed for P37 (Final Pendezvous Parameters) during MINKEY sequence. (Pefer to 11.2.7.)
		Poss OPR ERR		If another extended verb active.
	2	FL V16 N54		Display updated at 2-second intervals.
		Range XXX.XX NM		Range and range rate based on stored state vectors. Range and range rate displays may degrade considerably at ranges below ≈0.3 to 0.5 NM depending on marking schedules and resultant CMC navigation accuracy. Once this routine has started, changes to state vector caused by optics mark or VHF sample will not be reflected in displayed parameters.
		Range rate XXXX.X FPS		(-) range rate indicates closing. This calculation not sufficiently accurate for reliable terminal closing values. It should not be utilized without good visual cues.
		Theta (lcl horiz/ CSM +X) XXX.XX DEG		Theta - Angle included between +Xsc axis and local horizontal. Angle in range 0° to 180° indicates +Xsc axis is above local horizontal plane. Total range: 0° to 360°.
		PRO Return to prog in progress		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.4 (V85) Rendezvous Parameter Display #2 (R34)		Displays CMC calculated rendezvous parameters (range, range rate, and phi).
		CMC - on (req), 8.1.3		
		ISS - on & orient known (req), 8.1.3 & sec 13		Required for meaningful display of phi.
		Opt pwr up (req), 8.1.4		Required for meaningful display of phi.
CP	1	Key V85E	2,140	
		Poss OPR ERR		If another extended verb active.
	2	FL V16 N53		Display updated at 2-second intervals.
		Range XXX.XX NM Range rate XXXX.X FPS		Range and range rate computed based on stored Soyuz and CSM state vectors. (-) range rate indicates closing. Range and range rate displays may degrade considerably at ranges below ≈0.3 to 0.5 NM depending on marking schedules and resultant CMC navigation accuracy. Once this routine has started, changes to state vector caused by optics mark or VHF sample will not be reflected in displayed parameters.
		Phi (lcl horiz/ SLOS) XXX.XX DEG		Phi - Angle included between optics star line-of-sight and local horizontal. Angle in range 0° to 180° indicates SLOS is above local horizontal plane. Total range: 0° to 360°.
		PRO Return to prog in progress		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.5 (V90) Rendezvous Out of Plane Display (R36)		Displays CMC calculated rendezvous out-of-plane parameters.
		CMC - on (req), 8.1.3		
CP	1	Key V90E	2,140	
		Poss OPR ERR		If another extended verb active.
	2	FL V06 N16		
		GET event 00XXX. HRS		GET for which out-of-plane parameters desired. N16 initialized to TIG(N33) before this display. (Present time indicated by all zeros.)
		000XX. MIN		
		0XX.XX SEC		
		Accept PRO		
		Reject Key V25E		
		Load desired GET event		
	3	FL V06 N96 (rndz out of plane param)		
		Y (CSM) XXX.XX NM		
		Y dot (CSM) XXXX.X FPS		
		Y dot (Soyuz) XXXX.X FPS		
		Accept PRO		
		Exit R36		
		Reject Key V32E		To obtain additional data point.
		Return to 2 (adjust GET event)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.6 (V89) Rendezvous Final Attitude (R63)		Calculates final gimbal angles required to point either CSM +X axis or preferred tracking axis at SWS. Provides auto maneuver to selected attitude by calling R60.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1		
CP	1	Key V37E 00E	2,140	R63 may be selected from P00 only.
	2	Sel ISS Tot Att Disp, 7.2.5		Both FDAIs recommended so that either reference system (IMU or GDC) may be monitored. (CMC attitude error and rate display available.)
	3	Key V89E Poss PROG alarm		R02. (8.1.15)
	4	FL V06 N78 (SC vctr angles) Y, P XXX.XX DEG Accept PRO Reject Key V24E Load desired data		R1 and R2 initialized zero, R3 blanked.
	5	FL V06 N18 (computed GMBL angles) R, P, Y XXX.XX DEG		Computed required gimbal angles at selected tracking attitude as determined by N78 inputs if present IMU orientation maintained.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO Reject Key V32E (to update disp)	2,140	
	or Key V34E (to term routine)		
	(R60, Attitude Maneuver Routine)		Provides maneuver (automatic or manual) to attitude selected in 4.
	6 FL V50 N18 (auto mnvr request) R, P, Y XXX.XX DEG		Required gimbal angles.
AC	Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP	PRO Go to 7	2,140	
	Reject Key V62E RHC - null FDAI err needles		Provides reference for manual maneuver.
AC	or SC CONT - SCS (or CMC MODE ≠ AUTO)	1	Recomputes desired attitude without performing auto maneuver.
CP	PRO (to update disp) Recycle 6	2,140	
	or ENTR Exit R60/R63		Terminates R60.
	7 V06 N18 (auto mnvr) R, P, Y XXX.XX DEG		Non-flashing display until completion of auto maneuver, then returns to FL V50 N18. Maneuver rates will be as specified by last DAP data load (R03).
	Mon auto mnvr on FDAI Return to 6		When maneuver complete.

(V89) RENDEZVOUS FINAL ATTITUDE (R63)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.7 (P77) Target Delta V		P77 provides CSM maneuver parameters for updating CMC knowledge of CSM state vector. Keying V34E terminates P77 at any flashing display.
		CMC - on (req), 8.1.3		
CP	1	Key V37E 77E	2,140	
	2	FL V06 N33 GETI 00XXX. HRS 000XX. MIN 0XX.XX SEC Accept PRO Reject Key V25E Load desired GETI		
	3	FL V06 N81 ΔVX, Y, Z (CSM lcl vert) XXXX.X FPS Accept PRO Reject Key V25E Load desired data		CMC updates CSM state vector.
	4	FL V37 Key XXE		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	11.0	PRETHRUSTING		For general G&C operating data, refer to operating notes, 6.1.
	11.1	ORBIT CHANGE PRETHRUSTING		
	11.1.1	(P30) External Delta V Prethrusting		Accepts targeting parameters from sources external to CMC and computes, therefrom, required velocity and other initial conditions required by CMC for execution of ΔV maneuver. Targeting parameters include time of ignition (TIG) and impulsive ΔV along CSM local vertical axes at TIG. P30 displays, to flight crew and STDN, certain specific dependent variables associated with desired maneuver for approval by flight crew/ STDN.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		ISS must be on and its orientation known to obtain middle gimbal display (step 5).
CP	1	Key V37E 30E	2,140	At this point, P30 sets TRACK and UPDATE flags.
	2	FL V06 N33 GETI, stored 00XXX. HRS 000XX. MIN 0XX XX SEC Accept Rcd GETI PRO Reject V25E, load desired GETI		
	3	FL V06 N81 (VG compnts) VGX, Y, Z (lcl vert at GETI) XXXX.X FPS		Stored VG components along local vertical axes at GETI.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Accept PRO	2,140	PRO option resets UPDATE flag and sets external ΔV flag.
	Reject V25E, load desired data		
	4 FL V06 N42 (calculated thrust parameters)		
	Ha XXXX.X NM		Altitudes above launch pad radius. Measurements are limited to 9999.9 NM. Calculated Ha and Hp in P30 are considerably in error for long burns and should be ignored because parameters are computed (assuming an impulsive ΔV) at time of ignition along CSM local vertical axis. ΔV is magnitude of the impulsive ΔV vector at GETI.
	Hp XXXX.X NM		
	ΔV (req) XXXX.X FPS		
	Coord parameters with STDN (if available)		
	Accept PRO		
	Reject Reselect P30 or P27, load new parameters		
	5 FL V16 N45		
	Mrks (VHF/opt) XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. Optics mark counter does not distinguish between backup and primary marks.
-59:59	TF GETI (next burn) XXBXX MIN-SEC		Constraint - R2 cannot be >59B59 at this point. If TF GETI >59 min 59 sec, display limited. For full time to ignition display, use N35.
	MGA (next burn) XXX.XX DEG		MGA is displayed as -00002 at this point if IMU not on and orientation known (REFSMFLG reset). Otherwise, MGA at GETI displayed if CSM +X axis aligned with initial thrust direction.
	Rcd values		
	PRO		
	Align GDC to IMU, 8.4.6		

(P30) EXTERNAL DELTA V PRETHRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	FL V37 Key XXE	2,140	If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may recycle into P20 under certain conditions.
		Go to (P40) G&N/SPS Thrusting, 12.2.1 or (P41) G&N/SM RCS Thrusting, 12.2.2 or SCS Thrusting, 12.3 or (P52) IMU Realign, 13.1.3		IMU realign should be selected if MGA unsatisfactory in step 5.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2 RENDEZVOUS PREETHRUSTING		
		11.2.1 (P31) Normal Corrective Maneuver #1 (NC1)		Calculates and displays parameters associated with NC1 maneuver and ΔV burn. Keying V34E terminates P31 at any flashing display. Based on stored target parameters, the following parameters are computed and stored: TIG(NC2) in N28 — ΔV(NC2) in N84 TIG(NCC) in N11 — ΔH(NC2) in N84 TIG(NSR) in N13 — ΔV(NCC) in N84 ΔV(NC1-LV) in N81 — ΔV(NSR-LV) in N82 Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 8).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
CP	1	Key V37E 31E	2,140	If IMU on and aligned, P20 automatically turned on when P31 selected. P31 however, can be selected without P20 in background.
	2	FL V50 N25 00017 (request MINKEY)		Displayed for selection of MINKEY rendezvous sequence. Will occur here only if P31 selected as entry point to MINKEY sequence via V37E. If PRO, will not occur in subsequent programs.
		PRO (MINKEY) ENTR (manual) Go to 3		PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (P3) in P20 would be loaded as determined by state of REDSUPFLG. Also refer to 9.2.1, note 9.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10°		If maneuver <10°, R61 performs maneuver to tracking attitude.
CP		SC cont - CMC/AUTO	2,140	
		SC CONT - CMC		
		CMC MODE - AUTO		
		Go to 5		
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20.
				If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
		Poss PROG alarm		P20 (option 4).
		Key V05 N09E (to verify alarm)		
		00401 (MGA excessive)		
		If MGA >75°		Prevents maneuver into gimbal lock.
		CMC goes to att hold		
		RHC - manually mnvr to sel track att		Sets V50N18 flag.
		Key V58E		
		If mnvr <10°, go to 5		
		If mnvr ≥10°, go to 4		
		or Align IMU to acceptable orient, sec 13		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver $\geq 10^\circ$ as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver $\geq 10^\circ$ required.
CP	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change $\geq 10^\circ$	2,140	DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
		Reject Key V62E RHC - null FDAI error needles Recycle 4		Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	

(P31) NORMAL CORRECTIVE MANEUVER #1 (NC1)

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	When att satisfactory ENTR, go to 5	2,140	Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11.] If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5 FL V06 N95 GETI (NC1) OOXXX. HRS OOOXX. MIN OXX.XX SEC		
	Accept Rcd GETI (NC1) PRO Reject Key V25E Load desired GETI (NC1)		If P31 first program called in MINKEY sequence, GETI (NC1) must be loaded.
	6 FL V06 N57 1/2 revs XXXXX. ΔH (NCC) XXXX.X NM ΔH (NSR) XXXX.X NM		Number of 1/2 revs between NC1 and NC2.
	Accept Rcd data PRO Reject Key V25E Load desired data		

NORMAL BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	7	FL V06 N37		2,140	
		GETI (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept Rcd GETI (TPI) PRO			
		Reject Key V25E Load desired GETI (TPI)			
	8	FL V16 N45 (mnvr data)			
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken any time P20 operating.
		TF GETI (NC1)	XXBXX MIN-SEC		Time from NC1 ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 final pass, IMU not aligned.
		or IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
		To continue mark process Key V32E, go to 9			CMC computes NCC and NSR parameters.

(P31) NORMAL CORRECTIVE MANEUVER #1 (NC1)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	or To terminate mark process & do final pass Wait 15 sec		Allows processing of final mark.
CP	PRO, go to 9	2,140	CMC computes NCC and NSR parameters.
	Poss FL V05 N09 00600 failure in phase match iterations 00601 failure in either NC2 or NCC height mnvr iterations 00602 failure in outer (phase) loop iterations 00603 failure in QRDTPI iterations		
	Key V32E Return to 5		To adjust input parameters.
	or PRO If 00600, 00601, or 00603 Go to 10		Continue program without recycle.
	or After final pass PRO, go to 11		
	9 FL V06 N84 ΔV (NC2) XXXX.X FPS ΔH (NC2) XXXX.X NM ΔV (NCC) XXXX.X FPS Rcd data PRO		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	10	FL V06 N81 VGX, Y, Z (NC1) XXXX.X FPS Rcd data PRO, return to 8	2,140	CMC calculated components of VG (in local vertical coordinates) for NC1. N81 values will be zero if PRO after alarms 00600, 00601, or 00603 (step 8).
	11	FL V37 Key XXE		
	or	If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be $\geq$10 fps, controller proceeds to P40 sequence. If $\overline{VG}$ <10 fps, controller proceeds to P41.

(P31) NORMAL CORRECTIVE MANEUVER #1 (NC1)

STA/T STEP	PROCEDURE	PANEL	REMARKS
11.2.2	(P32) Normal Corrective Maneuver #2 (NC2)		Calculates and displays parameters associated with NC2 maneuver and ΔV burn. Successful completion dependent upon assumptions: a. Prescribed angle (E) exists at selected GETI (TPI). b. Computed variables may be stored for later STDN verification. P32 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P32 at any flashing display. Based on stored target parameters, the following parameters are computed and stored: TIG(NCC) in N11 — ΔV(NCC) in N84 TIG(NSR) in N13 — ΔV(NSR) in N84 ΔV(NC2-LV) in N81 — ΔV(NSR-LV) in N82 Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
	CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 8).
	DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
1	If MINKEY auto call Go to 3		If MINKEY selected in P31, P32 automatically called by MINKEY controller at completion of NC1 sequence.
CP or	Key V37E 32E	2,140	If IMU on and aligned, P20 automatically turned on. P32 however, can be selected without P20 in background.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V50 N25 00017 (request MINKEY) PRO (MINKEY) ENTR (manual) Go to 3 (R61, Tracking Attitude Routine)	2,140	Occurs only if MINKEY sequence initiated at this point. PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) in P20 would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9. Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute appropriate maneuver (R61/R60). 9.2.1, note 10.
	3	Maneuver If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5 If mnvr ≥10°, go to 4 Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		If maneuver <10°, R61 performs maneuver to tracking attitude. If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light. P20 (option 4).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E If mnvr <10°, go to 5 If mnvr ≥10°, go to 4	2,140	Prevents maneuver into gimbal lock. Sets V50N18 flag.
		or Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N28 GETI (NC2) OOXXX. HRS OOOXX. MIN OXX.XX SEC		
		Accept Rcd GETI (NC2) PRO Reject Key V25E Load desired GETI (NC2)		
	6	FL V06 N57 R2 ΔH (NCC) XXXX.X NM R3 ΔH (NSR) XXXX.X NM		

(P32) NORMAL CORRECTIVE MANEUVER #2 (NC2)

STA/T STEP	PROCEDURE		PANEL	REMARKS
CP	Accept Rcd data PRO		2,140	
	Reject Key V22E, or V23E Load desired data			
7	FL V06 N37			
	GETI (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC		
	Accept Rcd GETI (TPI) PRO			
	Reject Key V25E Load desired GETI (TPI)			
8	FL V16 N45 (mnvr data)			
	Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
	TF GETI (NC2)	XXBXX MIN-SEC		Time from NC2 ignition. Maximum reading 59B59. -, before; +, after.
	MGA	-0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
	or IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	To continue mark process Key V32E, go to 9	2,140	
or	To terminate mark process & do final pass PRO, go to 9		
	Poss FL V05 N09 00600 failure in phase match iterations 00601 failure in NCC height mnvr iterations 00602 failure in outer (phase) loop iterations 00603 failure in QRDTPI iterations		
	Key V32E Return to 5		
	or PRO If 00600, 00601, or 00603 Go to 10		
or	After final pass PRO, go to 11		

(P32) NORMAL CORRECTIVE MANEUVER #2 (NC2)

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	9	FL V06 N84		2,140	
		ΔV (NCC)	XXXX.X FPS		
		ΔH (NCC)	XXXX.X NM		
		ΔV (NSR)	XXXX.X FPS		
		Rcd data PRO			
	10	FL V06 N81			CMC calculated components of VG (in local vertical coordinates) for NC2. N81 values will be zero if PRO after alarms 00600, 00601, or 00603 (step 8).
		VGX, Y, Z (NC2)	XXXX.X FPS		
		Accept Rcd data PRO, return to 8			
		Reject Key V25E Load desired data			
	11	FL V37 Key XXE			
	or	If MINKEY, go to 12.2.1/12.2.2			For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	11.2.3 (P33) Normal Corrective Combination Maneuver (NCC)		Calculates and displays parameters associated with NCC maneuver and ΔV burn. Successful completion dependent on prior completion of P32 or ΔH(NSR) stored (pad load). P33 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P33 at any flashing display. Based on stored target parameters, the following parameters are computed and stored: ΔV(NCC) in N81 ΔV(NSR) in N82 Computations include out-of-plane component at NSR. -Y dot (CSM) is written into R2 of N82. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
	CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful NGA display during final N45 display (step 8).
	DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
	1 If MINKEY auto call Go to 3		If MINKEY initiated prior to P33, P33 automatically called by MINKEY controller at completion of NC2 sequence.
CP or	Key V37E 33E	2,140	If IMU on and aligned, P20 automatically turned on. P33, however, can be selected without P20 in background.
	2 FL V50 N25 00017 (request MINKEY)		Occurs only if MINKEY sequence initiated at this point.

(P33) NORMAL CORRECTIVE COMBINATION MANEUVER (NCC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PRO (MINKEY) ENTR (manual) Go to 3	2,140	PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5		If maneuver <10°, R61 performs maneuver to tracking attitude.
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		P20 (option 4).

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att		Prevents maneuver into gimbal lock.
CP		Key V58E	2,140	Sets V50N18 flag.
		If mnvr <10°, to to 5 If mnvr ≥10°, go to 4		
		or Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N73 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO	1	
		SC CONT - CMC CMC MODE - AUTO		
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

(P33) NORMAL CORRECTIVE COMBINATION MANEUVER (NCC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N11 GETI (NCC) OOXXX. HRS OOOXX. MIN OXX.XX SEC		
		Accept Rcd GETI (NCC) PRO		
		Reject Key V25E Load desired GETI (NCC)		
	6	FL V06 N13 GETI (NSR) OOXXX. HRS OOOXX. MIN OXX.XX SEC		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		Accept Rcd GETI (NSR) PRO		2,140	
		Reject Key V25E Load desired GETI (NSR)			
	7	FL V06 N37			
		GETI (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept Rcd GETI (TPI) PRO			
		Reject Key V25E Load desired GETI (TPI)			
	8	FL V16 N45			
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (if V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
		TF GETI (NCC)	XXBXX MIN-SEC		Time from NCC ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 for final pass (and IMJ not aligned).
	or	IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).

(P33) NORMAL CORRECTIVE COMBINATION MANEUVER (NCC)

STA T STEP	PROCEDURE	PANEL	REMARKS
	To continue mark process		
CP	Key V32E, go to 9	2,140	
or	To terminate mark process & do final pass PRO, go to 9		
	Poss FL V05 N09 00603 failure in QRDTPI iterations PRO, go to 10		
	or Key V32E, return to 5		To adjust input parameters.
or	After final pass PRO, go to 11		
9	FL V06 N82 ΔVX, Y, Z (NSR) XXXX.X FPS Rcd data PRO		CMC calculated components of VG (in local vertical coordinates) for NSR. CMC automatically incorporates the negative of the computed Y dot (CSM) into R2 of N82. Used for nulling out-of-plane component (Y dot) at appropriate time.
10	FL V06 N81 VGX, Y, Z (NCC) XXXX.X FPS Accept Rcd data PRO, return to 8 Reject Key V25E Load desired data		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	11	FL V37 Key XXE	2,140	
		or If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

(P33) NORMAL CORRECTIVE COMBINATION MANEUVER (NCC)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	11.2.4 (P34) Normal Slow Rate Maneuver (NSR)		Calculates and displays parameters associated with NSR maneuver and ΔV burn. Successful completion dependent on prior completion of P33 (NCC). P34 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P34 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
	CMC - cn (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 DAP - load & activate (desired), 8.2.1		Required for MINKEY and for meaningful MGA display during final N45 display (step 6). Required for auto maneuver to tracking attitude.
	1 If MINKEY auto call Go to 3		If MINKEY initiated prior to P34, P34 automatically called by MINKEY controller at completion of last burn sequence.
CP	or Key V37E 34E	2,140	If IMU on and aligned, P20 automatically turned on. P34, however, can be selected without P20 in background.
	2 FL V50 N25 00017 (request MINKEY) PRO (MINKEY) ENTR (manual) Go to 3		Occurs only if MINKEY sequence initiated at this point. PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
CP		If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5	2,140	If maneuver <10°, R61 performs maneuver to tracking attitude.
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		P20 (option 4).
		If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E If mnvr <10°, go to 5 If mnvr ≥10°, go to 4		Prevents maneuver into gimbal lock. Sets V50N18 flag.
		or Align IMU to acceptable orient, sec 13		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
CP		(If UPLINK ACTY lt on Key V58E)	2,140	Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Reject Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
AC	or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP	PRO Recycle 4	2,140	
	When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61 ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E) VHF marks automatic. Navigation automatic until final computation request.
5	FL V06 N13 GETI (NSR) OOXXX. HRS OOOXX. MIN OXX.XX SEC		
	Accept Rcd GETI (NSR) PRO		
	Reject Key V25E Load desired GETI (NSR)		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	6	FL V16 N45		2,140	
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
		TF GETI (NSR)	XXBXX MIN-SEC		Time from NSR ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
	or	IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
		To continue mark process Key V32E, go 7			
	or	To terminate mark process & do final pass PRO, go to 7			
		Poss FL V05 N09 00611 No GETI for given E PRO, go to 7			
		or Key V32E, return to 5			
	or	After final pass PRO, go to 9			

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	7	FL V06 N75		2,140	Maximum reading (displayed) in R2 and R3 is 59B59. Only minutes and seconds displayed although time computation done in hours, minutes, and seconds.
		Δ alt (NSR)	XXXX.X NM		
		ΔT (TPI -NSR)	XXBXX MIN-SEC		
		ΔT (TPI -nom TPI)	XXBXX MIN-SEC		TPI computed minus input TPI time (N37). GETI (TPI) available via V06 N37E.
		Rcd values PRO			
	8	FL V06 N81			
		VGX, Y, Z (NSR)	XXXX.X FPS		CMC calculated components of VG (in local vertical coordinates) for NSR. CMC automatically incorporates the negative of the computed Y dot (CSM) out-of-plane component (Y dot) at appropriate time.
		Accept Rcd data PRO, return to 6			
		Reject Key V25E Load desired data			
		If desired Key N90E FL V06 N90			
		Y (CSM)	XXX.XX NM		
		Y dot (CSM)	XXXX.X FPS		
		Y dot (Soyuz)	XXXX.X FPS		
		Rcd data KEY REL			

(P34) NORMAL SLOW RATE MANEUVER (NSR)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	9	FL V37 Key XXE	2,140	
		or If MINKEY, to to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be >10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2.5 (P35) Transfer Phase Initiation (TPI)		P35 Transfer Phase Initiation calculates required ΔV and other initial conditions required by CMC for CSM execution of TPI maneuver, given: a. Time of ignition, nominal GETI (TPI), or elevation angle (E) of CSM-to-Soyuz LOS at GETI (TPI). b. Central angle of transfer (CENTANG) of passive vehicle from GETI (TPI) to time of intercept. CENTANG = 130° (fixed memory). c. Calculates GETI (TPI) given E, or E given nominal GETI (TPI). P35 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P35 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 DAP - load & activate (desired), 8.2.1		Required for MINKEY and for meaningful MGA display during final N45 display (step 7). Required for auto maneuver to tracking attitude.
	1	If MINKEY auto call Go to 3		If MINKEY initiated prior to P35, P35 automatically called by MINKEY controller at completion of NSR sequence.
CP	or	Key V37E 35E	2,140	If IMU on and aligned, P20 automatically turned on. P35, however, can be selected without P20 in background.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V50 N25 00017 (request MINKEY) PRO (MINKEY) ENTR (manual) (R61, Tracking Attitude Routine)	2,140	Occurs only if MINKEY sequence initiated at this point. PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9. Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5 If mnvr ≥10°, go to 4 Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		9.2.1, note 10. If maneuver <10°, R61 performs maneuver to tracking attitude. If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light. P20 (option 4).

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E If mnvr <10°, go to 5 If mnvr ≥10°, go to 4	2,140	Prevents maneuver into gimbal lock. Sets V50N18 flag.
	or Align IMU to acceptable orient, sec 13		
	(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
	(If UPLINK ACTY lt on) Key V58E		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
	R, P, Y XXX.XX DEG		Required gimbal angles.
AC	Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP	PRO	2,140	This may be performed second time as attitude trim.
	V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

(P35) TRANSFER PHASE INITIATION (TPI)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V62E	2,140	Provides reference for manual maneuver.
		RHC - null FDAI error needles		
		Recycle 4		
		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
		PRO	2,140	
		Recycle 4		
		When att satisfactory ENTR, go to 5		Terminate Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N37		
		GETI (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC	
		Accept Rcd GETI (TPI)		
		PRO		
		Reject Key V25E		
		Load desired GETI (TPI)		Load desired GETI (TPI) if CMC computation of E desired. For a specified value of E and CMC computation of GETI (TPI), load an initial value of GETI (TPI). Loaded value should be within 30 minutes of actual.

NORMAL BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	6	FL V06 N55		2,140	
		NN	0000X.		Integration method and number of precision offset computations desired. NN initially +00000.
		E	XXX.XX DEG		Elevation angle (pad loaded erasable).
		Accept Rcd E PRO			
		Reject Key V24E Load desired data			Load desired NN in R1: 0, conic integration; X, precision integration with (X) target offsets. Desired E in R2, CMC computes GETI (TPI). +00000 in R2, CMC computes E.
	7	FL V16 N45			After recycle from step 11, V06 N59 may be keyed for required impulsive ΔV components in an orthogonal coordinate system oriented along CSM to Soyuz LOS. (For complete definition, refer to GSOP section 5.4.6 of R693.)
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
		TF GETI (TPI)	XXBXX MIN-SEC		Time from TPI ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
	or	IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).

(P35) TRANSFER PHASE INITIATION (TPI)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	To continue mark process		
CP	Key V32E	2,140	
	If E = 0, go to 8		
	If E ≠ 0, go to 9		
	or To terminate mark process & do final pass		
	PRO		
	If E = 0, go to 8		
	If E ≠ 0, go to 9		
	or After final pass		
	PRO, go to 12		
8	If +00000 specified for E (CMC computes E)		
	FL V06 N55		
	NN 0000X.		Integration method and number of precision offset computations desired.
	E XXX.XX DEG		CMC computed E based on N37 GETI (TPI).
	Rcd E		
	PRO, go to 10		
9	If E specified (CMC computes GETI)		
	Poss FL V05 N09		
	00611 (no GETI for given E)		
	PRO, return to 5		
	(adj input parameters)		

STA/T STEP	PROCEDURE		PANEL	REMARKS
CP	FL V06 N37		2,140	
	GETI (TPI)	OOXXX. HRS OOOXX. MIN OXX.XX SEC		
	Rcd GETI (TPI)			
	PRO, go to 10			To accept computed GETI (TPI).
	or Key V25E Load desired GETI (TPI)			Reject computed GETI (TPI), specify GETI (TPI) and allow CMC to compute E.
	or PRO, go to 10 If MINKEY & final pass PRO, return to 8			
10	FL V06 N58			
	ΔV (TPI)	XXXX.X FPS		
	ΔV (TPF)	XXXX.X FPS		
	ΔT (TPI -nom TPI)	XXBXX MIN-SEC		TPI computed minus input TPI time (N37).
	Rcd data PRO			

(P35) TRANSFER PHASE INITIATION (TPI)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	11	FL V06 N81 VGX, Y, Z (TPI) XXXX.X FPS Accept Rcd data PRO, return to 7 Reject Key V25E Load desired data	2,140	CMC calculated components of VG (in local vertical coordinates) for TPI. To modify VG (lcl vert) to correct for out of planeness, key V90E (R36). Use data obtained from R36 to determine desired VG (lcl vert).
	12	FL V37 Key XXE		
	or	If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2.6 (P36) Transfer Phase Midcourse (TPM)		P36 Transfer Phase Midcourse calculates required ΔV and other initial conditions required by CMC for execution of next midcourse correction of transfer phase. Successful completion dependent on prior completion of P35 (TPI). P36 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P36 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 5).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
	1	If MINKEY auto call Go to 3		If MINKEY initiated prior to P36, P36 automatically called by MINKEY controller at completion of TPI sequence, and again after completion of first midcourse (TPM) burn.
SPT	or	Key V37E 36E	2,140	If IMU on and aligned, P20 automatically turned on. P36, however, can be selected without P20 in background.
	2	FL V50 N25 00017 (request MINKEY)		Occurs only if MINKEY sequence initiated at this point.

(P36) TRANSFER PHASE MIDCOURSE (TPM)

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	PRO (MINKEY) ENTR (manual) Go to 3	2,140	PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by status of HDSUPFLG. Also refer to 9.2.1, note 9.
	(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
3	Maneuver		9.2.1, note 10.
	If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5		If maneuver <10°, R61 performs maneuver to tracking attitude.
	If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
	Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		P20 (option 4).

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att		Prevents maneuver into gimbal lock.
CP	Key V58E	2,140	Sets V50N18 flag.
	If mnvr <10°, go to 5 If mnvr ≥10°, go to 4		
	or Align IMU to acceptable orient, sec 13		
	(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
	(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
	R, P, Y XXX.XX DEG		Required gimbal angles.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	Accept	SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
	Reject	Key V62E RHC - null FDAI error needles Recycle 4		Provides reference for manual maneuver.
AC	or	SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E) VHF marks automatic. Navigation automatic until final computation request.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP 5	FL V16 N45	2,140	
	Marks XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
	TF GETI (TPM) XXBXX MIN-SEC		(-): Time from previous burn (TPI or TPM 1) before final pass. (+): Time from TPM ignition after final pass. Maximum reading 59B59.
	MGA -0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
	or IMU aligned +XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
	To continue mark process Key V32E, go to 6		
	or To terminate mark process & do final pass PRO, go to 6		
	or After final pass PRO, go to 7		

(P36) TRANSFER PHASE MIDCOURSE (TPM)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	FL V06 N59 ΔVX, Y, Z (LOS) XXXX.X FPS Accept Rcd data PRO, return to 5 Reject Key V25E Load desired data	2,140	CMC calculated components of ΔV for TPM oriented along CSM to Soyuz LOS.
	7	FL V37 Key XXE		
	or	If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2.7 (P37) Transfer Phase Final (TPF)		Displays CMC calculated rendezvous parameters (range, range rate, and theta). Initiates automatic maneuver to X-axis tracking attitude. P37 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P37 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 DAP - load & activate (desired), 8.2.1		Required for auto maneuver to X-axis tracking attitude.
	1	MINKEY auto call		CMC executes V83 (R31). R1 and R2 of N78 (P20) set to zero prior to initiating R31.
CP	or	Key V37E 37E	2,140	If IMU on and aligned, P20 automatically turned on. P37, however, can be selected without P20 in background.
	2	FL V50 N25 00017 (request MINKEY) PRO (MINKEY) ENTR (manual)		Occurs only if MINKEY sequence initiated at this point. PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		(R61, Tracking Attitude Routine)	2,140	Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10°		
AC		SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5	1	If maneuver <10°, R61 performs maneuver to specified (N78) tracking attitude.
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver to specified (N78) tracking attitude). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
CP		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)	2,140	P20 (option 4).
		If MGA >75°		
AC CP		CMC goes to att hold RHC - manually mnvr to sel track att Key V58E If mnvr <10°, go to 5 If mnvr ≥10°, go to 4		Prevents maneuver into gimbal lock.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	or	Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req pointing angle change ≥10°	2,140	DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI	2,140	This may be performed second time as attitude trim. Priority display.
		Reject Key V62E RHC - null FDAI error needles Recycle 4		Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	

(P37) TRANSFER PHASE FINAL (TPF)

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	When att satisfactory ENTR, go to 5	2,140	Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and gimbal angle error, as determined by R61, ≥10 degrees.
	Poss OPR ERR		If another extended verb active. (Not expected on P37 call by MINKEY.)
5	FL V16 N54		Display updated at 2-second intervals.
	R XXX.XX NM		Range and range rate based on stored state vectors. Range and range rate may degrade considerably at ranges below ≈0.3 to 0.5 NM depending on marking schedules and resultant navigation accuracy.
	R dot XXXX.X FPS		(-) range rate indicates closing. This calculation not sufficiently accurate for reliable terminal closing values. It should not be utilized without good visual cues.
	Theta (lcl horiz/ CSM +X) XXX.XX DEG		Theta - Angle included between +Xsc axis and local horizontal. Angle in range 0° to 180° indicates +Xsc axis is above local horizontal plane. Total range: 0° to 360°.
	PRO		
	If MINKEY, go to 8.1.7 Manual FL V37 Key XXE		(P48) Rendezvous Thrust Monitor (final phase).

11.2.7 (P37) TRANSFER PHASE FINAL (TPF)

NORMAL/BACKUP

STA/T STEP		PROCEDURE	PANEL	REMARKS
	11.2.5	(P38) Normal Plane Change Targeting (NPC)		Computes and displays out-of-plane parameters required for execution of plane change maneuver, e.g., for one case of a non-coplanar condition, an antinode is established as a function of the NCC maneuver (P33). P38 then, targets a second nulling maneuver to be performed 90° later (at the node at the appropriate time), resulting in desired CSM, Soyuz, coplanar orbits. P38 is called by manual selection only (V37E 38E). It is not called automatically by the MINKEY controller as part of the normal MINKEY rendezvous sequence. P20 on FL V50 N25 (00017) however, does provide MINKEY controller functions (P20, P52 call for gyro torquing, etc.) within the NPC sequence. Keying V34E terminates P38 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CSC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for P38 MINKEY and for meaningful MGA display during final N45 display (step 7).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
CP	1	Key V37E 38E	2,140	If IMU on and aligned, P20 automatically turned on. P38, however, may be selected without P20 in background.

(P38) NORMAL PLANE CHANGE TARGETING (NPC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V50 N25 00017 (request MINKEY)	2,140	
		PRO (MINKEY) ENTR (manual) Go to 3		PRO initiates NPC MINKEY sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10°		
AC		SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5	1	If maneuver <10°, R61 performs maneuver to tracking attitude.
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
CP		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)	2,140	P20 (option 4).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If MGA >75°		
CP		CMC goes to att hold		Prevents maneuver into gimbal lock.
		RHC - manually mnvr to sel track att		
		Key V58E	2,140	Sets V50N18 flag.
		If mnvr <10°, go to 5		
		If mnvr ≥10°, go to 4		
		or Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO	1	
		SC CONT - CMC		
		CMC MODE - AUTO		
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
		R, P, Y XXX.XX DEG		
		Monitor auto mnvr on FDAI		

(P38) NORMAL PLANE CHANGE TARGETING (NPC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60, (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N39 GETI (last mnvr) 00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept Rcd GETI (last mnvr) PRO		
		Reject Key V25E Load desired GETI (last mnvr)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	6	FL V06 N33 GETI (NPC)	00XXX. HRS 000XX. MIN 0XX.XX SEC	2,140	Time 1/4 rev after time specified in N39.
		Rcd data PRO			
	7	FL V16 N45 (mnvr data) Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically). Optics marks may be taken anytime P20 operating.
		TF GETI (NPC)	XXBXX MIN-SEC		Time from NPC ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 final pass, IMU not aligned.
		or IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
		To continue mark process Key V32E, go to 8			
		or To terminate mark process & do final pass PRO, go to 8			
		or After final pass PRO, go to 9			

(P38) NORMAL PLANE CHANGE TARGETING (NPC)

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	or If MINKEY and If VG = 0 (bypass gyro torquing) If VG >0, go to 13.1.3		Bypass gyro torquing option in P52. Controller selects P52 for gyro torquing option. If gyros not torqued, P41 automatically selected. If gyros torqued, and VG computed to be ≥10 fps, controller proceeds to P40 sequence; if VG <10 fps, controller proceeds to P41.
8	FL V06 N81 VGX, Y, Z (lcl vert) XXXX.X FPS Accept Rcd data PRO, return to 7 Reject Key V22E Load desired data If desired Key N90E FL V06 N90 (rndz out of plane param) Y (CSM) XXX.XX NM Y dot (CSM) XXXX.X FPS Y dot (Soyuz) XXXX.X FPS Rcd data KEY REL	2,140	CMC calculated components of VG (in local vertical coordinates) for NPC. CMC automatically incorporates the negative of the computed Y dot (CSM) into R2 of N81 (R1 and R3 = 0). Used for nulling out-of-plane component (Y dot) at appropriate time.
9	FL V37 Key XXE		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.0 THRUSTING		For general G&C operating data, refer to operating notes, 6.1.
		12.1 VEHICLE PREPARATION		
		(Proced not designated as "req" are optional		
		1 For orb change		
		Obtain update from STDN		
CP		Gas Separator Cartridge Prep (req)		
		Remove separator from water pistol & stow temporarily in LEB stowage bag		
		Assure separator on food prep unit secured with bayonet locks		
		Install outlet cap on food prep unit separator		
		SPS and SM RCS Checks, 5.2.1 & 5.2.2		
		EPS DC & AC Checks, 5.3.2 & 5.3.3		
		Pres Suit Ckt & PGA Check at 5.0 psia, 5.4.9 (if req)		
		C&WS Oper Check, 5.5.1		
		CMC Self Check, 8.1.8		
		DSKY Condition Light Check, 8.3.1		
		Dry tunnel		If necessary, absorb water with towel. Condensed moisture in tunnel rains on crew during thrusting.
		ΔV Test & Null Bias Check, 7.6.1		In-flight verification of X-axis accelerometer output, ΔV indicator, SPS THRUST light, and thrust cutoff relay in EMS.
		If preparing for NC2 rndz mnvr		
AC		DIRECT O2 vlv - close (CW)	7	DIRECT O2 valve closed after minimum of 3 hours total operation from launch.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		For PSM activation		Nominal mission requires that PSM be activated after 50 lbs primary (quad) propellant has been expended. Provides adequate contingency blowdown capabilities and ensures sufficient RCS quad propellant for hybrid deorbit.
AC		SM RCS PSM He - OPEN	2	
		PSM He tb - gray		
		SM RCS QUAD PRPLNT (4) - CLOSE		
		SM RCS PSM PRPLNT (4) - OPEN		
		SM RCS QUAD PRPLNT tb (8) - bp		
		SM RCS PSM PRPLNT tb (4) - gray		
		SM RCS QUAD He (4) - CLOSE		
		SM RCS QUAD He tb (4) - bp		
	2	For deorbit		
		Deorbit & Entry Veh Prep, 14.1 (req)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	12.2 G&N THRUSTING		
	12.2.1 (P40) G&N/SPS Thrusting		Computes preferred CSM attitude and IMU orientation for SPS thrusting maneuver. Calculates and displays gimbal angles which would result if present IMU orientation used for thrusting in preferred vehicle attitude (function of R60 computations). Crew then decides whether to thrust at present IMU orientation or to reorient IMU using P52/P54. Maneuvers CSM to thrusting attitude (R60). Controls GNCS during SPS thrust countdown, ignition, thrust, and thrust termination; and allows residual steering error trimming. P40 should not be performed in CSM-Soyuz docked configuration.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
	Test C/W lamps DAP - load & activate, including ull sel, 8.2.1		SPS trim values should be reviewed now for use at beginning of P40 for computing preferred IMU orientation and final vehicle attitude. SPS trim values are updated during CMC-controlled burn. If a roll jet fails on during SPS thrust, an appreciable roll excursion ≈30° may occur. PITCH-YAW DAP will continue to function properly.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Prethrust prog (req), sec 11		P31 through P38 may have been performed during MINKEY sequence.
	Veh Prep (req), 12.1		
1	ΔV Setup, 7.6.2		
2	Key V37E 00E (non-MINKEY)	2	P00 updates state vector periodically. State vector automatically updated during MINKEY.
3	Key V37E 40E		
or	MINKEY auto call		During MINKEY rendezvous sequence, if VG is computed to be ≥10 fps, MINKEY controller (R07) automatically calls P40 at completion of targeting sequence (P31 through P37) or in case of NPC sequence (P38), P40 called at completion of gyro torquing (P52) if VG ≥10 fps.
	Poss PROG alarm (8.1.15)		R02. If no alarm at this point (after R02 exited), CMC computes initial thrust direction and initial value of VG (local vertical), computes preferred IMU orientation, and sets PFRATFLG (preferred attitude flag) and stores desired attitude for use in R60. Final attitude computed in R60, gimbals trimmed for initial thrust, and 0.5-degree deadband set in RCS DAP.
4	If VG display desired Key V06 N81E VGX, Y & Z (lcl vert at GETI) XXXX.X FPS KEY REL		Display available until average G turned on (GETI minus 30 seconds).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60 - Attitude Maneuver)		Maneuvers CSM to attitude stored in P40. Maneuver performed automatically by G&N, or manually with an optional final automatic G&N-controlled trim maneuver.
	5	FL V50 N18 (sel CMC - auto) R, P, Y XXX.XX DEG		Desired final gimbal angles.
		Establish Total Att disp, 7.2.5		Both FDAIs should be selected to provide redundant displays.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - Auto, 7.1.6	1	Prevents BMAGs from hitting stops during maneuvers.
CP		PRO	2	PRO initiates auto maneuver without reviewing final gimbal angles. If review desired prior to auto maneuver, reject option should be selected. If desired, attitude set control panel can then be set to final gimbal angles to provide attitude error information for completion of maneuver manually if G&N fails.
		Reject Sel desired Att Cont, 7.1 Mnvr to thrust att ENTR - Go to 7		
	6	Auto mnvr V06 N18 (final att) R, P, Y XXX.XX DEG		Angles obtained from a VECPOINT calculation. Maneuver rate is as last defined by DAP load.
AC,CP		Mon FDAIs If RHC used or SCS sel, go to 7	1,2	CSM began maneuver to final attitude when PRO keyed in step 5. Refer to 6.1.3, notes 1b and 1c.
CP	7	FL V50 N18 (att trim enbl) R, P, Y XXX.XX DEG	2	Final trim maneuver should be considered essential to SPS ΔV attitudes. Display of final gimbal angles remains in registers. Final attitude trim maneuver performed after gimbal drive and trim check.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	8	Ign prep		Sets up nontime-critical switching required for thrusting. If necessary for deorbit, STDN dumps and rewinds tape recorder, and changes to HBR.
		CAUTION If either bat bus A(B) current fails to incr after cycling respective MN BUS TIE sw, configure bats to main buses using cb BAT BUS A(B) BAT C & cb MNA(B) BAT C as necessary.	275	Assumes reconfiguration BAT C to MNA(B) for orbit change; BAT A(B) and BAT C to MNA(B) for deorbit.
-06:00		MN BUS TIE BAT A/C - on (up)	5	
		Verify bat bus A current incr &/or bat volt decr	3	Verification of current increase for appropriate bat bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line for orbit change if cb MNA & B BAT C (2) - open, or three batteries on line for deorbit burn and entry if cbs closed (panel 275).
		MN BUS TIE BAT B/C - on (up)	5	
		Verify bat bus B current incr &/or bat volt decr	3	
		SPS He VLV tb (both) - bp SPS He VLV (both) - AUTO		Barber pole indicates helium isolation valves closed.
AC		RHC PWR DIR (both) - OFF	1	
		SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO		
		SCS TVC (2) - RATE CMD		Provides rate damped manual TVC as backup to G&N, if THC - CW. SCS auto or MTVC acceleration command optional, but less desirable backup modes.

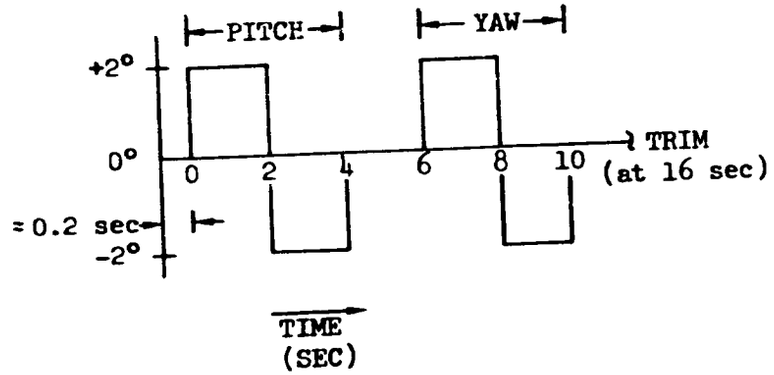
(P40) G&N SPS THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		BMAG MODE (3) - ATT 1/RATE 2 DBD/RATE - MIN/LO ATT DBD - MIN RATE - LO LV IND/GPI sw - GPI (verify) TVC GMBL DR (2) - AUTO	1	
	9	Gmbl drive & trim check		PITCH and YAW GMBL caution/warning lights (panel 2) indicate overcurrent to actuator motors.
		TVC SERVO PWR 1 - AC1/MNA TVC SERVO PWR 2 - AC2/MNB	7	
		THC PWR - on (up)	1	
		RHC PWR NORM 2 - AC		Opens RHC 2 (commander's) breakout switch (dc circuits) to prevent attitude maneuvers through CMC during MTVC checks. During burn, RCS DAP disabled at SPS engine ignition (TFI = 0).
		RHC 2 - ARMED		
-05:00		GMBL MOT P1 & Y1 - START		START position is momentary. Also refer to 6.1.1, note 12.
		Auto switchover check THC - CW		Enables MTVC and switches TVC to channel 2.
		RHC - verify no MTVC control GMBL POS ind (4) - no motion		Verifies TVC switches from channel 1 to channel 2 (which is off) when THC CW selected.
		Sec TVC check GMBL MOT P2 & Y2 - START Confirm & set trim cont		START position is momentary. Verifies secondary gimbal trim control.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SPS GMBL tw (2) - + & - Set to c.g. trim values	1	Trim values obtained from DAP Data Load (8.2.1), or STDN.
		RHC 2 - Verify MTVC		Gimbals drive in response to RHC movement and return to set-in values when RHC neutral. Verifies control of secondary MTVC loops through RHC. Gimbals move proportional to RHC deflection since MTVC integrator not enabled until engine ignition.
		THC - neut RHC PWR NORM 2 - AC/DC		
	Accept	Complete auto att trim		Accept and reject options refer to attitude trim enable flash V50 N18 in step 7.
		BMAG MODE (3) - RATE 2 Align CSM in roll CMC Att Cont - Auto, 7.1.6		
CP		PRO Returns to V06 N18 disp of step 6	2	Does not imply that any previous checks need be repeated for each trim enable.
	Reject	Sel desired Att Cont, 7.1 Verify/mnvr to thrust att (V62E for tot att err disp)		
AC		RHC PWR DIR (both) - MNA/MNB MAN ATT (3) - RATE CMD	1	Enables manual direct RCS for overriding an auto RCS roll failure during thrusting.
		RATE - HI		If MTVC required, RATE - HI bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels, which can cause spurious RCS roll jet firings.
		BMAG MODE (3) - ATT 1/RATE 2		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	or If RATE 1 ΔV planned BMAG MODE PITCH - RATE 1 BMAG MODE YAW - RATE 1	1	RATE 1 ΔV should be used for burns where angular change >15° or if gyro assembly 2 failed.
	or BMAG MODE (in axis) - RATE 1		
	Align GDC to IMU if necessary, 8.4.6		DSKY display option recommended because of its availability - only need to set ATT SET thumbwheels to DSKY values and defer alignment until just prior to thrust.
CP	Check boresight star ENTR (exit R60)	2	
10	FL V50 N25 00204 (CMC GMBL drive test)		Manual drive, trim and MTVC check accomplished before CMC gimbal drive test enabled (PRO keyed).
	Accept PRO Mon GMBL drive seq		



NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject ENTR GMBLs drive to trim position (after 4 sec)	2	If gimbal test sequence not desired, gimbals drive to trim 4 seconds after ENTR keyed.
	11	V06 N40		
		TF GETI XXBXX MIN-SEC VG XXXX.X FPS ΔV (accum) XXXX.X FPS		TF GETI max reading is 59B59. Sign minus before nominal GETI, plus after. Event Timer will not agree with R1 if GETI was slipped.
AC	12	1-min countdown		
-01:00		Report TF GETI = 1 min FDAI SCALE - 5/5	1	
		ΔV THRUST A(B) - NORM THC - ARMED		Guarded.
AC,CP		RHC (both) - ARMED		
		(R41 - State Vector Integration)		
-00:40		Poss PROG Alarm	2	May illuminate between TIG -42.5 and -35 seconds.
CP		Key V05 N09E 01703 (TIG slipped) KEY REL R1 of N40 continues count to former TIG DSKY clears at new TIG -35 sec		TIG slipped delta amount as required by CMC to complete state vector integration
		COMP ACTY lt - out (exit R41)		
-00:35		DSKY clears		
-00:30		V06 N40 (ave G on)		Dynamic, nonflashing display, with COMP ACTY lt flash every 2 seconds.

(P40) G&N SPS THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Check ΔV (accum) for PIPA bias R3 ≤0002.0 FPS	2	G&N controlled burns unreliable if R3 >0002.0 FPS.
DP		UP TLM CMD - RSET then NORM PCM BIT RATE - HI	3	
AC		TAPE RCDR FWD - FWD EMS MODE - NORM	1	6.1.1, note 10.
	-00:29 to -00:06	Perform ull		2 or 4 jet ullage times defined in MSC-07765-VOL I, Part I. Retain ullage for ≈1 second after ignition. Exact velocity change not critical - only a steady ullage to settle SPS propellants.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		No ull DIR ULL pb - push, hold RHC - control att		Direct ullage inhibits pitch and yaw auto RCS. Maintain attitude within deadband limits.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	-00:05			
CP	⊥3	FL V99 N40 (eng enbl) TF GETI XXBXX MIN-SEC VG XXXX.X FPS ΔV (accum) XXXX.X FPS	2	CMC changes V06 to V99, but retains previous display in registers. Do not exercise extended verb or monitor displays for extended periods during TVC; these displays can override a FL V97 N40 (low thrust) display which indicates CMC thinks engine off, steering stopped (including cutoff computations), and attitude hold established.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO Go to 14	2	
	Reject ENTR, go to 18 as req & 19 Man trim with RCS		If ENTR option selected, post SPS burn switching in step 18 must be accomplished.
	or V34E FL V37		If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
AC 14 Ign 00:00	SPS THRUST lt - on	1	If N46 (digit A) configured for DM off, CMC will not accept V46E or V48E during TVC. Although not expected, if N46 (digit A) configured for DM on, CMC will accept V46E for low bandwidth mode (decreases control required response because of off-nominal bending moments).
CP	V06 N40	2	
	TFC XXBXX MIN-SEC		Time from engine cutoff. Sign (-) before cutoff, (+) thereafter. TFC display discontinuous for 4 to 5 seconds after ignition.
	VG (decr) XXXX.X FPS ΔV accum (incr) XXXX.X FPS		
AC	ΔV ind - decr	1	
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 01407 (VG incr)	2	
IGN+1 sec AC	Discontinue ull		RCS X-axis translation discontinued by program 2 seconds after engine-on command. RCS DAP disabled at ignition.

(P40) G&N SPS THRUSTING

STA/T STEP	PROCEDURE	PANEL	REMARKS
IGN+2 to 5 sec AC	ΔV THRUST (2) - NORM (if desired)	1	Guarded. For dual bank operation.
	If no ign or premature shutdown		Engine restart should not be attempted within 5 seconds from initial ignition - avoids undesirable helium pressure excursions.
	Continue ull ΔV THRUST (2) - NORM Recycle 14		Guarded.
CP	or If FL V97 N40 (R40) PRO - If thrust back on	2	Thrust failure routine (R40) called if CMC detects thrust failure during non-impulsive thrusting period. If thrust decreases to some low level, VG and ΔV displays continue changing. If thrust actually terminates prematurely, VG and ΔV displays become static. For Lambert burns, VG may not become static.
AC	or ΔV THRUST (2) - NORM Reorient to thrust att	1	
CP	ENTR - Recycle to 13	2	If ENTR response to FL V97 N40, R1 (TFC) set to 59B59. A slight delay (≈3 sec) occurs before FL V99 N40 appears.
	or Key V34E FL V37 Key XXE		Terminates P40 and R40.
	or Sel SCS option		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	or Discontinue ull SC CONT - SCS ΔV THRUST (2) - NORM SCS TVC (2) - AUTO	1	SCS ΔV option selected to bypass as many failure modes as possible and provide minimum engine delay. Depending on duration of burn prior to failure, a motion transient could result if c.g. shifted significantly from GMBL thumbwheel values.
	Initiate ull THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic if SPS THRUST switch not at DIR ON.
	or SPS THRUST - DIR ON		Lever lock.
IGN+1 sec	Discontinue ull		
	or Term muvr		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
15	Orb change SPS monitor Pc ind - 95-105 psia		65 to 125% green range on indicator corresponds to psia. Normal Pc range 95-105 psia.
CP	SPS INJ VLV ind (2 or 4) - OPEN SPS He VLV tb (both) - gray SPS FUEL & OXID PRESS ind (2) - 170-195 psia SPS OXID UNBAL ind - 0 psi	3	All four injector valves open for dual-bank operation. Gray indicates helium isolation valves open. PUGS deactivated.
	CAUTION		
AC	If noncritical burn & ΔP >20 psi ΔV THRUST (2) - OFF	1	ΔP between fuel and oxidizer should not exceed 20 psi during burn or degraded performance; rough combustion, and/or engine failure may result.

(P40) GIN SPS THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	16	Deorbit SPS monitor Pc ind - 95-105 psia	1	65 to 125% green range on indicator corresponds to psia. Normal Pc range 95-100 psia.
DP		SPS INJ VLV ind (4) - OPEN SPS He VLV tb (both) - gray SPS FUEL & OXID PRESS ind (2) - 170-195 psia	3	All four injector valves open for dual-bank operation. Gray indicates helium isolation valves open.
AC or CP	17	FDAI - monitor err & rates	1,2	Monitoring for possibly required MTVC takeover.
		xxxx

STA/T	STEP	PROCEDURE	PANEL	REMARKS
IGN+2 to 5 sec Ac		ΔV THRUST B(A) - NORM (if desired)	1	Guarded. For dual bank operation.
		Initiate ull THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic for second bank operation if SPS THRUST switch not at DIR ON.
		or SPS THRUST - DIR ON		Lever lock.
		or Term mnvr		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Roll att cont failure MAN ATT ROLL - ACCEL CMD		ACCEL CMD position inhibits CMC roll commands and allows acceleration control of RCS auto coils with RHC.
		or AUTO RCS ROLL (8) - OFF Use direct cont	8	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	18	Mon SPS eng cutoff SPS THRUST lt - out	1	
CP		FL V16 N40 (eng cutoff)	2	
		TFC (static at 2.5 sec from cutoff) XXBXX MIN-SEC		Time from cutoff. At cutoff +2.5 seconds, CMC sets wide deadband in RCS DAP. Then CMC switches from TVC DAP to RCS DAP at cutoff +3.1 seconds.
		VG XXXX.X FPS		
		ΔV (accum) XXXX.X FPS		

(P40) G&N SPS THRUSTING

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	EVNT TMR ind - 59:59 (-) thrust duration	1	Timer normally counts down from 59:59.
C/O+1 sec	ΔV THRUST (2) - OFF		Guarded.
	SPS THRUST - NORM (verify)		Lever lock.
	Report eng off		
	Pc = 0		
DP	SPS INJ VLV ind (4) - CLOSE	3	
	SPS He VLV tb (both) - bp		Barber pole indicates helium isolation valves closed.
C/O			
+2.5 sec			
AC	GMBL POS ind (4) - servo null	1	CMC removes TVC enable discrete (C/O indicated by TFC sign change and VG → 0).
	For postorbit change free drift		
	BMAG MODE (3) - RATE 2		
	CMC MODE - FREE		
DP	DC IND sel - SM SOURCE 3	3	
	DC AMPS ind - mon for amps decr after each No. 2 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC	GMBL MOT P2 & Y2 - OFF	1	6.1.1, note 12.
DP	DC IND sel - SM SOURCE 1 or 2	3	
	DC AMPS ind - mon for amps decr after each No. 1 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC	GMBL MOT P1 & Y1 - OFF	1	
DP	DC IND sel - MNA	3	
	If MTVC		
	THC - neut		To prevent possible reignition (if G&N thrust-on command still present), ΔV THRUST switches must be OFF prior to THC - neutral.
AC	TVC SERVO PWR (both) - OFF	7	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		If deorbit cb SPS PITCH (both) - open cb SPS YAW (both) - open EMS MODE - STBY	1	6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
AC		Record ΔV ind	1	
CP		PRO	2	CMC sets minimum deadband in RCS DAP.
	19	FL V16 N85 (VG vctr compnt) VGX, Y, Z (cont) XXXX.X FPS		Velocity to be gained resolved along CSM X, Y, and Z control axes (updated each computation cycle).
AC		If VG compnt to be nulled CMC MODE - AUTO or HOLD RHC/THC - null out VG compnt THC - neut, LOCKED	1	Optional. All AUTO RCS switches must be on for nulling residuals in 3 axis.
		If orb change RHC - LOCKED		
DP		If deorbit TAPE RCDR FWD - off (ctr)	3	
CP		If R30 desired Key V82E Go to 20	2	
		To term P40 PRO Go to 21		CMC sets last specified R03 deadband in RCS DAP.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	(R30 - Orbital Parameter Display)		
20	FL V16 N44		
	Ha XXXX.X NM Hp XXXX.X NM		Altitudes above launch pad radius. Parameter calculations yield reasonable results if vehicle close to earth.
	TFF XXBXX MIN-SEC		Time of free fall to 49.4 NM (300,000 ft) above launch pad radius.
	If Hp >49.4 NM R3 = -59B59 PRO (exit R30) Return to 19		If TFF = -59B59, time from perigee available via N32E.
21	FL V37 (non-MINKEY)		If average G on, R00 turns off average G. R00 also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
	If orb change Key XXE (non-MINKEY) Set controls after tailoff		Monitor main bus voltage for maximum allowable (31 vdc) during power down sequence.
DP	MN BUS TIE (2) - OFF	5	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If MN BUS TIE fail prior to thrust Leave MN BUS TIE BAT B/C(A/C) - on (up) Go to EPS Malf, Pwr Distr, SSR-2 reconfig for subsequent main bus ties xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		Circuit breakers used to reconfigure for subsequent bat bus operation and battery charging procedures in place of opening (known) good main bus tie motor switches. Malfunction procedures are in Flight Data File (FDF).

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Rcd burn data	2	Recorded burn data should include ΔV accomplished and SPS propellant quantity remaining.
AC		EMS FUNC - OFF THC PWR - OFF RHC PWR DIR (both) - OFF Charge bats, 5.3.5	1	
		If MINKEY, go to next MINKEY seq		MINKEY controller proceeds to next targeting program in MINKEY sequence.
	or	If deorbit		
CP		Rcd burn data Key 61E Go to CM/SM Sep, 14.2	2	Recorded burn data should include ΔV accomplished.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.2.2 (P41) G&N/SM-RCS Thrusting		Computes preferred CSM attitude and preferred IMU orientation for RCS thrust, and maneuvers CSM to thrust attitude (R60).
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
		Test C/W lamps Prethrust prog (req), sec 11		P31 through P38 may have been performed during MINKEY sequence. During MINKEY rendezvous sequence, if VG is computed to be <10 fps, controller automatically calls P41 at completion of targeting sequence (P31 through P37) or in case of NPC sequence (P38), P41 called at completion of P52 if gyros not torqued, or if gyros torqued and VG <10 fps.
		Veh Prep (req), 12.1 DAP - Load & Activate, (R03) 8.2.1, or (R04), 8.2.2		May be R03 and V46E if not docked, or R04 and V45E if CSM docked to Soyuz.
AC	1	Set EVNT TMR to read 00:00 at GETI	1	
CP	2	Key V37E 00E (non-MINKEY)	2	
	3	Key V37E 41E		TFI available (prior to step 11) via N35, N40, or N45.
	or	MINKEY auto call		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Poss PROG alarm (8.1.16)	2	R02. If no alarms at this point (after R02 exited), CMC computes initial thrust direction and initial value of VG (local vertical), computes preferred IMU orientation, and sets PFRATFLG (preferred attitude flag) and stores desired attitude for use in R60. Final attitude computed in R60 and 0.5-degree deadband set in RCS DAP.
	4	If VG disp desired Key V06 N81E VGX, Y, Z XXXX.X FPS (Lcl vert at GETI) KEY REL		Display available until average G turned on (GETI -30 seconds).
		(R60 - Attitude Maneuver)		Maneuvers CSM to attitude stored in P41. Maneuver performed automatically by G&N, or manually with optional final automatic G&N controlled trim maneuver.
	5	FL V50 N18 (select CMC - auto) R, P, Y XXX.XX DEG		Desired final gimbal angles.
		Establish Tot Att disp, 7.2.5		Both FDAIs should be selected to provide redundant displays.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - auto, 7.1.6	1	Prevents BMAGs from hitting stops during maneuvers.
CP		PRO	2	Initiates auto maneuver without review of final gimbal angles.
AC		Reject Sel desired Att Cont, 7.1 Mnvr to thrust att		
CP		ENTR, go to 8		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	Auto mnvr V06 N18 (fnl att) R, P, Y XXX.XX DEG	2	
AC, CP		Mon FDAIs If RHC used or SCS sel, go to 7	1,2	CSM began maneuver to final attitude when PRO keyed in step 5. ICDU drives to achieve final gimbal angles. Refer to 6.1.3, notes 1b and 1c.
	7	FL V50 N18 (att trim enbl) R, P, Y XXX.XX DEG		Step should be completed prior to TIG -2 minutes. Display of final gimbal angles in registers.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - Auto, 7.1.6	1	
CP		PRO Return to V06 N18 display of 6	2	Does not imply that any previous checks need be repeated for each trim enable.
AC		Reject Sel desired Att Cont, 7.1 Verify/mnvr to thrust att		All RCS channels required for 3-axis translation.
CP		(V62E for total att err disp)		
AC		MAN ATT (3) - RATE CMD BMAG MODE (3) - ATT 1/RATE 2 Align GDC to IMU if necessary, 8.4.6	1	DSKY display option recommended because of its availability - only need to set ATT SET thumbwheels to DSKY values and defer alignment until just prior to thrust.
CP		ENTR (exit R60)	2	
	8	Mon VG disp V06 N85 (VG vctr compnts) VGX, Y, Z (cont) YXXX.X FPS		Components resolved along CSM axes, and updated at 1-second intervals.

STA/T STEP	PROCEDURE	PANEL	REMARKS
-05:00			
9	Ign prep		Sets up nontime-critical switching required for thrust.
AC	Check boresight star	1	
	For X axis thrust		
	THC PWR - on (up)		
	If orb change		
	ΔV Test and Null Bias Check, 7.6.1		For deorbit thrust, check accomplished during EMS Entry Test, 14.1.3, if desired.
	ΔV Setup, 7.6.2		Set to ΔV obtained from charts, P30, and/or STDN.
	(R41 - State Vector Integration)		
-00:40	Poss PROG alarm		May illuminate between TIG -42.5 and -35 seconds.
CP	Key V05 N09E	2	TIG slipped delta amount as required by CMC to complete state vector integration.
	01703 (TIG slipped)		
	KEY REL		
	R1 of N40 continues count to former TIG		
	DSKY clears at new TIG -35 sec		
10	COMP ACTY lt - out (exit R41)		
-00:35	DSKY clears		
-00:30			
11	V16 N85 (ave G on)		Dynamic, nonflashing display with COMP ACTY light flash every 2 seconds.

(P41) G&N SM RCS THRUSTING

STA/T STEP	PROCEDURE	PANEL	REMARKS
-00:25			
AC	THC - ARMED		
AC,CP	RHC (both) - ARMED	1	For SCS translations.
AC	LIM CYCLE - OFF	3	
DP	UP TLM CMD - RSET then NORM		
	PCM BIT RATE - HI		
	TAPE RCDR FWD - FWD		
AC	EMS MODE - NORM	1	6.1.1, note 10.
00:00			
12	RCS thrust		
CP	FL V16 N85 (requests null VG)	2	Event Timer not valid if GETI slipped.
	VGX, Y, Z (cont) XXXX.X FPS		
AC	Man null VG		Command manual translations and rotations to null VG components.
CP	If R30 desired		
	Key V82E		
	Go to 13		
	To term P41		
	PRO		CMC sets last specified R03 deadband in RCS DAP.
	Go to 14		
	(R30 - Orbital Parameter Display)		R30 displays automatically updated at 2-second intervals if called because average G still on.
13	FL V16 N44		
	Ha XXXX.X NM		Altitudes above launch pad radius.
	Hp XXXX.X NM		
	TFF XXBXX MIN-SEC		Time of free fall to 49.4 NM (300,000 ft) above launch pad radius.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If Hp >49.4 NM R3 = -59B59 PRO (exit R30) Return to 12	2	If TFF = -59B59, time from perigee available via N32E.
	14	Thrust complete		
AC		EMS MODE - STBY	1	6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
AC		Rcd ΔV ind	1	
		If orb change EMS FUNC - OFF THC PWR - OFF		
AC,CP		RHC (both) - LOCKED		
		If deorbit		
DP		TAPE RCDR FWD - off (ctr)	3	
AC		THC - neut, LOCKED		
CP	15	FL V37 (non-MINKEY)	2	If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
		If orb change Key XXE		
	or	If deorbit Key 61E (if desired) Go to CM/SM Sep, 14.2		P61 may be bypassed if hybrid or SCS deorbit.
		If MINKEY, go to next MINKEY seq		MINKEY controller proceeds to next targeting program in MINKEY sequence.

(P41) G&N SM RCS THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.2.3 G&N/Hybrid Deorbit Thrusting		Computes preferred CSM attitude and preferred IMU orientation for RCS thrusting maneuver. Maneuvers CSM to thrusting attitude (R60), and provides sufficient displays for cutoff of both SM RCS burn followed by CM RCS deorbit burn.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
		Test C/W lts Prethrust prog (req), sec 11 Veh Prep (req), 12.1 DAP - Load & Activate, 8.2.1		
AC	1	Set EVNT TMR to read 00:00 at GETI	1	
		Key V37E 00E	2	P00 updates state vector periodically.
CP	2	Key V37E 41E		TFI available via N35, N40, or N45.
		Poss PROG alarm (8.1.16)		R02. If no alarms at this point (after R02 exited), CMC computes initial thrust direction and initial value of VG (local vertical), computes preferred IMU orientation, sets PFRATFLG (preferred attitude flag), and stores desired attitude for use in R60. Final attitude computed in R60 and 0.5-degree deadband set in RCS DAP.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
C	3	If VG disp desired Key V06 N81E VGX, Y, Z XXXX.X FPS (Lcl vert at GETI)	2	Display available until average G turned on (GETI -30 seconds).
		(R60 - Attitude Maneuver)		Maneuvers CSM to attitude stored in P41. Maneuver performed automatically by G&N, or manually with an optional final automatic G&N controlled trim maneuver.
	4	FL V50 N18 (sel CMC - auto) R, P, Y XXX.XX DEG		
		Establish Tot Att disp, 7.2.5		Both FDAIs should be selected to provide redundant displays.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - auto, 7.1.6	1	Prevents BMAGs from hitting stops during maneuvers.
CP		PRO	2	Initiates auto maneuver without review of final gimbal angles.
AC CP		Reject Sel desired Att Cont, 7.1 ENTR, go to 7		
	5	Auto mnvr V06 N18 (final att) R, P, Y XXX.XX DEG		
AC,CP		Monitor FDAIs	1,2	CSM began maneuver to final attitude when PRO keyed in step 4. ICDU drives to achieve final gimbal angles.
		If RHC used or SCS sel, go to 6		Refer to 6.1.3, note 1b.

G&N HYBRID DEORBIT THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	FL V50 N18 (att trim enbl) R, P, Y XXX.XX DEG	2	Step should be completed prior to TIG -2 minutes. Display of final gimbal angles in registers.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - auto, 7.1.6	1	
CP		PRO, return to 5	2	
AC		Reject Sel desired Att Cont, 7.1 Verify/mnvr to thrust att		
CP		(V62E for tot att err disp)		
AC		MAN ATT (3) - RATE CMD BMAG MODE (3) - ATT 1/RATE 2	1	DSKY display option recommended because of its availability - only need to set ATT SET thumbwheels to DSKY values and defer alignment until just prior to thrust.
CP		ENTR (exit R60)	2	
	7	Mon VG disp V06 N85 (VG vctr compnts) VGX, Y, Z (cont) XXXX.X FPS		Components resolved along CSM axes and updated at 1-second intervals.
DP	8	Configure & preload bats		Prepares for battery preloading prior to CM/SM separation and verifies batteries transferred to main buses.
		CAUTION If either bat bus A(B) current fails to incr after cycling MN BUS TIE sws, configure bats to main buses using cb BAT BUS A(B) BAT C.	275	Assumes reconfiguration BAT A(B) and BAT C to MNA(B). cb MNA(B) BAT C closed in Deorbit and Entry Vehicle Preparation, 14.1.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
-06:00		MN BUS TIE BAT A/C - on (up)	5	
DP		Verify bat bus A current incr &/or bat volt decr	3	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches.
		MN BUS TIE BAT B/C - on (up)	5	
		Verify bat bus B current incr &/or bat volt decr	3	MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line if circuit breaker MNA & B BAT C (2) - open, or three batteries on line for deorbit and entry if circuit breakers closed (panel 275).
-05:00				
AC	9	Ign prep		Sets up nontime-critical switching required for thrusting.
		THC PWR - on (up)	1	
		ΔV Setup, 7.6.2		Set to ΔV obtained from charts, P30, and/or STDN.
		(R41 - State Vector Integration)		
-00:40		Poss PROG alarm		May illuminate between TIG -42.5 and -35 seconds.
CP		Key V05 N09E	2	TIG slipped delta amount as required by CMC to complete state vector integration.
		01703 (TIG slipped)		
		KEY REL		
		R1 of N40 continues count to former TIG		
		DSKY clears at new TIG -35 sec		
	10	COMP ACTY lt - out (exit R41)		
-00:35		DSKY clears		
-00:30				
	11	V16 N85 (ave G on)		Dynamic, nonflashing display with COMP ACTY light flash every 2 seconds.

G&N HYBRID DEORBIT THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
-00:25				
AC,CP		RHC (both) - ARMED		
AC		THC - ARMED		
		LIM CYCLE - OFF	1	For SCS translations.
DP		UP TLM CMD - RSET then NORM	3	
		PCM BIT RATE - HI		
		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
00:00				
CP	12	SM RCS thrust		
		FL V16 N85 (request null VG)	2	Event Timer not valid if GETI slipped.
		VGX, Y, Z (cont) XXXX.X FPS		
AC		Man null VG		Command manual translation and rotation to null VG components.
		Mon DSKY, ΔV ind, & EVNT TMR	1,2	
CP		Crew options		
		V83 - R, R dot, θ	2	
		V82 - Ha, Hp, TFF		
	13	SM RCS thrust complete		
AC		EMS MODE - STBY	1	6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
CP		Rcd DSKY, ΔV ind, & EVNT TMR values	1,2	
AC		Reset EVNT TMR	1	
		THC - neut, LOCKED		
	14	Sel SCS Att Cont mode, 7.1		Separation follows immediately, preventing proper G&N DAP operation until entry DAP selected in P62.
	15	Perform Sep proced, 14.2		Separation at SM deorbit attitude saves time. Only one minute allowed between burns.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	16	Verify/mnvr to CM RCS deorbit att R____°, P____°, Y____°		Both CM RCS systems should be enabled. CM RCS deorbit portion complete with +X axis ≈70° below velocity vector (apex down and forward); ≈110° +pitch maneuver from heads down, REF, SM RCS portion of deorbit.
		MAN ATT YAW, ROLL - RATE CMD MAN ATT PITCH - ACCEL CMD DBD/RATE - MIN/HI ATT DBD - MIN RATE - HI	1	
AC,CP		RHC (both) - ARMED		
AC		FDAI SCALE - 5/5		
CP	17	Key V82E	2	
		FL V16 N44		
		Ha XXXX.X NM		Altitudes above launch pad radius.
		Hp XXXX.X NM		
		TFF XXBXX MIN-SEC		Time of free fall to 49.4 NM (300,000 ft) above launch pad radius.
AC	18	EVNT TMR ind - SM RCS C/O +2 min	1	Two minutes after SM RCS cutoff, start CM RCS burn. 6.1.1, note 10.
		EMS MODE - NORM		
CP		RHC 1 - contin -pitch		
AC		RHC 2 - pulse to maintain att in pitch axis		Negative pitch engines have ≈25 to 30 percent less authority than positive engines because of engine location and thrust direction relative to CM c.g.
		Mon FDAI		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If only 1 RHC		
AC,CP		Pulse RHC + & - in pitch from pitch retro att, maintaining rates <3°/sec		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

G&N HYBRID DEORBIT THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	19	Mon Hp & TFF on DSKY	2	Monitor Event Timer for duration of burn no greater than 02:10 for either single or dual system. Conserve CM RCS propellant reserves, 30 lb each system for entry. ΔV indicator cutoff cue must be adjusted to account for EMS sensing axis (along X) being reversed from SM RCS deorbit burn and biased off ±70° from CM RCS velocity vector. (ΔVems = ΔVcm Cos 70°).
	20	PRO FL V16 N85 VGX, Y, Z (cont) XXXX.X FPS		
	21	Thrust complete, ΔV ind = _____ or	1	
		EVNT TMR = _____		
		PRO	2	
AC		MAN ATT (3) - RATE CMD	1	
		Rcd ΔV ind, DSKY, EVNT TMR	1,2	
DP		TAPE RCDR FWD - off (ctr)	3	
AC		ATT DBD - MAX	1	
CP	22	FL V37	2	
AC		EMS MODE - STBY	1	6.1.1, note 10.
AC,CP		RHC (both) - LOCKED		
AC	23	Sel Att Cont mode, 7.1 Mnvr to entry att R____°, P____°, Y____°		
	24	Set up for CM RCS sys 1 AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (6) - MNA or MNB AUTO RCS CM 2 (6) - OFF	8	Electrically isolates system 2 for entry. If problem develops in system 1, disable affected channel and use direct RCS control.
	25	Go to G&N Entry, 14.3		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.3 SCS THRUSTING		
		12.3.1 SCS/SPS Thrusting		
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2		CMC and ISS on, and orientation known, necessary for P47 monitor. G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
		Vehicle Pr.p (req), 12.1		
		For small impulse SPS/SCS burn Set ΔV ind - ΔVc		Initial counter setting (ΔVc) and counter reading for SPS ignition cue (ΔVf) will be provided by SLDN or determined from on-board charts. (Ref CSM Data Book Vol I, Part I.)
	1	ΔV Setup, 7.6.2		
CP	2	Key V37E 00E	2	P00 updates state vector periodically.
	3	Establish Tot Att disp, 7.2.5		To obtain telemetry on BMAG attitude error, FDAI SEL switch must be in 1 or 2 position (with SCS displays).
	4	SCS Att Mnvr to thrust att, 8.4.5		
	5	Establish SCS Att Hold, 7.1.4 Check boresight star		Limit cycle, maximum deadband and low rate should be selected for propellant conservation.
	6	Ign prep		Sets up nontime-critical switching required for thrusting.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SPS He VLV tb (both) - bp SPS He VLV (both) - AUTO	3	Barber pole indicates helium isolation valves closed.
		CAUTION If either bat bus A(B) current fails to incr after cycling MN BUS TIE sws, configure bats to main buses using cb BAT BUS A(B) BAT C & cb MNA(B) BAT C as necessary.	275	Assumes reconfiguration BAT C to MNA(B) for orbit change; BAT A(B) and BAT C to MNA(B) for deorbit.
-06:00		MN BUS TIE BAT A/C - on (up) Verify bat bus A current incr &/or bat voltage decr MN BUS TIE BAT B/C - on (up) Verify bat bus B current incr &/or bat voltage decr	5	Verification of current increase for appropriate bat bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line for orbit change if cb MNA & B BAT C (2) - open, or three batteries on line for deorbit burn and entry if cbs closed (panel 275).
		LV IND/GPI sw - GPI (verify)		
AC		RHC PWR DIR (both) - OFF SCS TVC (2) - AUTO TVC GMBL DR (2) - AUTO ATVC GAIN - HI	1	LO position provides proper response for tw control of SPS gimbals.
		Establish U11 Sel, 6.1		
CP	7	If P47 for thrust monitor Key V37E 47E	2	GN& monitoring highly desirable but not required. Refer to 8.1.6 for P47 description.
		Poss PROG alarm (8.1.16)		R02.

NORMAL/BACKUP

S/C A/T	STEP	PROCEDURE		PANEL	REMARKS
CP		FL V16 N83		2	
		ΔVX, Y, Z (cont)	XXXX.X FPS		
		If desired			
		KEY N62E			
		VI	XXXXX. FPS		Inertial velocity.
		H dot	XXXXX. FPS		Altitude rate.
		H pad	XXXX.X NM		Altitude above launch pad radius.
		KEY REL (to return to N83)			
	8	Gmbl drive & trim check			PITCH and YAW GMBL caution/warning lights indicate overcurrent to actuator motors.
AC		TVC SERVO PWR 1 - AC1/MNA		7	
		TVC SERVO PWR 2 - AC2/MNB			
		cb SPS PITCH 1 BAT A - close (verify)			Remain closed from launch through first SPS thrust and closed again for each subsequent SPS thrusting.
		cb SPS YAW 1 BAT A - close (verify)			
		THC PWR - on (up)		1	
		RHC PWR NORM 2 - AC			Opens RHC 2 (commander's) breakout switch dc circuits to prevent loss of attitude reference. Prevents RCS jets from firing when RHC used for MTVC check. Normally, IGN 1 signal disables RCS pitch and yaw channels 1 second after SPS engine ignition.
		RHC 2 - ARMED			
		Primary TVC check			6.1.1, note 12.
-05:00		GMBL MOT P1 & Y1 - START			START position is momentary.
		Verify trim control on ind			Gimbals drive in response to thumbwheel movement. Verifies primary gimbal trim control.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Auto switchover check THC - CW RHC 2 - verify no MTVC GMBL POS ind (4) - no motion	1	Verifies TVC control switches from channel 1 to channel 2 (which is off) when THC - CW.
		Sec TVC check GMBL MOT P2 & Y2 - START Verify trim control		START position is momentary. Verifies secondary gimbal trim control.
		Verify MTVC THC - neut		Gimbals drive in response to RHC movement, and return to set-in values when RHC neutral. Verifies control of secondary MTVC loops through RHC.
		SPS GMBL tw (2) - set & confirm fnl desired gmbl position		Gimbals trimmed in primary channel to thrusting values (SCS modes).
	9	RHC PWR DIR (both) - MNA/MNB		Enables manual direct RCS for overriding a roll auto RCS failure during thrusting.
		RHC 2 - null att err		Needles can be used as error null reference during MTVC contingency takeover from automatic ΔV mode.
		ATT DBD - MIN RHC PWR NORM (both) - AC/DC Check boresight star		Set to MIN as errors nulled.
CP -01:00 AC	10	1-min countdown Report TF GETI = 1 min FDAI SCALE - 5/5 ΔV THRUST A(B) - NORM	2 1	Guarded.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		THC - ARMED LIM CYCLE - OFF	1	
DP		UP TLM CMD - RSET, then NORM PCM BIT RATE - HI	3	
-00:30		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
-00:29 to -00:06		Perform ull		2 or 4 jet ullage times defined in MSC-07765-Vol I, Part I. Exact velocity change not critical - only steady ullage to settle SPS propellants.
		For small impulse SPS/SCS burn THC - +X Mon EMS counting down When EMS ind = ΔVf THRUST ON pb - push SPS THRUST lt - on Discontinue ull when SPS thrusting		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		No ull DIR ULL pb - push, hold RHC 2 - control att		Direct ullage inhibits pitch and yaw auto RCS control. Attitude should be maintained manually.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	11	Orb change ign		Engine restart should not be attempted within 5 seconds from initial ignition - avoids undesirable He pressure excursions.
00:00		If ull present THRUST ON pb - push		

SCS/SPS THRUSTING

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	If no ull present THC - +X, hold THRUST ON pb - push SPS THRUST lt - on	1	Provides ullage discrete to SCS.
IGN+1 sec	RATE - HI		Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
	Discontinue ull		
IGN +2 to 5 sec	ΔV THRUST (2) - NORM (if desired)		For dual bank operation.
	Initiate ull THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic for second bank operation.
	If no ign, or premature shutdown ΔV THRUST (2) - NORM Recycle ll		
	or SPS THRUST - DIR ON Recycle ll		Lever lock.
	or Term mnvr		
12 00:00	Deorbit ign SPS THRUST - DIR ON		Engine restart should not be attempted within 5 seconds from initial ignition to avoid undesirable He pressure excursions.
	SPS THRUST lt - on		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC IGN+1 sec	RATE - HI	1	Bypasses noise problem in SCS gyrc assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If no ign ΔV THRUST (2) - NORM Recycle 12		Guarded.
	or Term mnvr		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Discontinue ull		
IGN +2 to 5 sec	ΔV THRUST (2) - NORM		Guarded.
13	Orb change SPS monitor Pc ind - 95-105 psia		65 to 125% green range on indicatcr corresponds to psia. Normal range 95-105 psia.
DP	SPS INJ VLV ind (2 or 4) - OPEN SPS He VLV tb (both) - gray SPS FUEL & OXID PRESS ind (2) - 170-195 psia SPS OXID UNBAL ind - 0 psi	3	All four injector valves open for dual-bank operation. Gray indicates helium isolation valves open. PUGS deactivated.
	CAUTION If noncritical burn & ΔP >20 psi.		ΔP between fuel and oxidizer should not exceed 20 psi during burn or degraded performance, rough combustion and/or engine failure may result.
AC	ΔV THRUST (2) - OFF	1	Guarded.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	14	Deorbit SPS Monitoring		
AC		Pc ind - 95-105 psia	1	
DP		SPS INJ VLV ind (4) - OPEN	3	
		SPS He VLV tb (both) - gray		Gray indicates helium isolation valves open.
		SPS FUEL & OXID PRESS ind (2) - 170-195 psia		
AC or CP	15	FDAI - mon att err & rates	1,2	
		xxxx

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Fly MTVC (rate cmd)		
IGN+2 to 5 sec	ΔV THRUST B(A) - NORM (if desired)	1	For dual bank operation.
	Initiate ullage THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic for second bank operation if SPS THRUST switch not at DIR ON.
	or SPS THRUST - DIR ON		Lever lock.
	or Term mnvr		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Orb change roll err & rates abnormal & no roll att cont MAN ATT ROLL - ACCEL CMD RHC - cont roll rates		
	or AUTO RCS (16) - OFF Cont roll using dir RCS	8	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Deorbit MTVC takeover If err & rates abnormal ΔV THRUST (2) - OFF Damp rates to IMU ball or out window with RHC SPS THRUST - NORM	1	Backup procedure bypasses maximum possible failure modes, thereby providing an alternate means of completing burn without troubleshooting. Lever lock.

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	If no response Use dir RCS & disable affected chan		Since a failure causing abnormal TVC and RCS attitude control is not a failed-on jet, RCS disabling should be done with MAN ATT switch to ACCEL CMD rather than AUTO RCS switches - OFF, thereby providing automatic RCS control for reorientation.
	If rate needle(s) abnormal BMAG MODE - RATE 1	1	
	Reorient to thrust att THC - CW ΔV THRUST A(B) - NORM Initiate ull SPS THRUST - DIR ON Fly MTVC (rate cmd)		Guarded. Lever lock.
IGN+2 to 5 sec	ΔV THRUST (2) - NORM		Guarded.
	or Term mnvr		
	Deorbit nc roll att cont MAN ATT ROLL - ACCEL CMD RHC - cont roll rates		
	or AUTO RCS (16) - OFF Cont roll using dir RCS	8	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	16	Mon for SPS eng cutoff cue		
		ΔV ind - goes through -0.1	1	For suspected ΔV indicator failures, utilize Event Timer to terminate SPS thrust manually. Timer normally counts down from 59:59.
		&/or EVNT TMR ind - 59:59 (-) thrust duration		
		ΔV THRUST (2) - OFF		Guarded.
		SPS THRUST - NORM		Lever lock.
		SPS THRUST lt - out		
		For postorbit change free drift		
		MAN ATT (3) - ACCEL CMD		
		Report eng cutoff		
		Pc = 0		
DP		SPS INJ VLV ind (4) - CLOSE	3	
		SPS He VLV tb (both) - bp		Barber pole indicates helium isolation valves closed.
	17	Set controls after tailoff		
		DC IND sel - SM SOURCE 3		
		DC AMPS ind - mon for amps decr after each No. 2 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P2 & Y2 - OFF	1	6.1.1, note 12.
DP		DC IND sel - SM SOURCE 1 or 2	3	
		DC AMPS ind - mon for amps decr after each No. 1 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P1 & Y1 - OFF	1	
DP		DC IND sel - MNA	3	
AC		EMS MODE - STBY	1	6.1.1, note 10.
		If orb change		
DP		PCM BIT RATE - LO	3	
AC		Rcd ΔV ind	1	
		TVC SERVO PWR (both) - OFF	7	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If orb change		
AC		cb SPS PITCH 1 BAT A - open	8	
		cb SPS YAW 1 BAT A - open		
		If deorbit		
		cb SPS PITCH (both) - open		
		cb SPS YAW (both) - open		
		ATT DBD - MAX	1	
		THC - LOCKED		
		If deorbit		
DP		TAPE RCDR FWD - off (ctr)	3	
		If orb change		
AC,CP		RHC (both) - LOCKED		
AC		RHC PWR DIR (both) - OFF		
CP		(To re-zero registers, V32E)	2	Provides capability to monitor another burn without going through R00.
	18	PRO (exit P47)		When P47 termination desired.
	19	FL V37		
		Key XXE		
		If deorbit		
		Go to CM/SM Sep. 14.2		
	20	If orb change		
CP		MN BUS TIE (2) - OFF	5	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If MN BUS TIE fail prior to thrust		
CP		Leave MN BUS TIE BAT B/C(A/C - on (up)	5	Circuit breakers used to reconfigure for subsequent bat bus operation and battery charging procedures in place of opening (known) good main bus tie motor switches. Malfunction procedures are to be found in Flight Data File (FDF).
		Go to EPS Malf, Pwr Distr, SSR-2 reconfig for subsequent main bus ties		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		EMS FUNC - OFF	1	
		Charge bats, 5.3.5		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.3.2 SCS/SM RCS Thrusting		
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2 Veh Prep (req), 12.1		CMC and ISS on, and orientation known, necessary for P47 monitor.
CP	1	Key V37E 00E	2	P00 updates state vector periodically.
	2	Establish Tot Att disp, 7.2.5		
	3	Sel desired Att Cont, 7.1 Mnvr to thrust att		All RCS channels required for 3-axis thrusting.
	4	Establish SCS Att Hold, 7.1.4		Limit cycle, max deadband and low rate should be selected for propellant conservation until prior to thrusting.
-05:00 AC	5	Check boresight star		
	6	For X-axis thrust If orb change ΔV Test & Null Bias Check, 7.6.1		EMS can monitor only Xsc axis thrusting. For deorbit thrust, check accomplished during EMS Entry Test, 14.1.3, if desired.
		ΔV Setup, 7.6.2		Set to ΔV obtained from charts, P30, and/or STDN.
CP	7	If P47 for thrust monitor Key V37E 47E		G&N monitoring highly desirable, but not required. Refer to 8.1.6 for P47 description.
		Poss PROG alarm (8.1.16)		R02.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		FL V16 N83	2	
		ΔVX, Y, Z (cont) XXXX.X FPS		
		If desired		
		Key N62E		
		VI XXXXX. FPS		Inertial velocity.
		H dot XXXXX. FPS		Altitude rate.
		H pad XXXX.X NM		Altitude above launch pad radius.
		KEY REL (to return to N83)		
-00:30				
AC,				
CP	8	RHC (both) - ARMED		
AC		THC - ARMED		
		ATT DBD - MIN	1	
		LIM CYCLE - OFF		
DP		UP TLM CMD - RSET then NORM	3	
		PCM BIT RATE - HI		
		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
00:00				
	9	Perform thrust by manually nulling ΔV ind		
CP		If PSM deorbit, mon SM RCS QTY ind	2	
		If <___%		
		PRO (exit P47)		
AC		EMS MODE - STBY	1	
CP		Rcd ΔV ind		
		SM RCS PSM PRPLNT (4) - CLOSE	2	
		SM RCS PSM PRPLNT tb (4) - bp		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		SM RCS PSM He - CLOSE PSM He tb - bp SM RCS QUAD He (4) - OPEN SM RCS QUAD He tb (4) - gray SM RCS QUAD PRPLNT (4) - OPEN SM RCS QUAD PRPLNT tb (8) - gray Return to 1		
AC, DP	10	EMS MODE - STBY PCM BIT RATE - LO	1 3	6.1.1, note 10.
AC		Rcd ΔV compnts	1	
		If orb change EMS FUNC - OFF		
AC,DP		RHC (both) - LOCKED		
AC		THC - neut, LOCKED		
DP		If deorbit TAPE RCDR FWD - off (ctr)	3	
CP		(To re-zero registers, V32E)	2	Provides capability to monitor another burn without going through R00.
	11	PRO (exit P47)		
	12	FL V37 Key XXE		R00 turns off average G.
	13	If deorbit Go to CM/SM Sep, 14.2		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.3.3 SCS Hybrid Deorbit Thrusting		This procedure can be utilized for a pure CM RCS deorbit by omitting steps 10 and 11.
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2 Veh Prep (req), 12.1		CMC and ISS on, and orientation known, necessary for P47 monitor.
CP	1	Key 037E 00E	2	P00 updates state vector periodically.
	2	Establish Tot Att disp, 7.2.5		
	3	Sel desired Att Cont, 7.1		Thrusting attitude for SM RCS portion of hybrid burn is nominally a retrograde +X translation with heads down and BEF.
		Mnvr to thrust att R____°, P____°, Y____°		
	4	Establish SCS Att Hold, 7.1.4		Limit cycle, maximum deadband, and low rate should be selected for propellant conservation until prior to thrusting.
DP	5	Configure & preload bats		Prepares for battery preloading prior to CM/SM separation and verifies batteries transferred to main buses.
		CAUTION If either bat bus A(B) current fails to incr after cycling MN BUS TIE sws, configure bats to main buses using cb BAT BUS A(B) BAT C.	275	Assumes reconfiguration BAT A(B) and BAT C to MNA(B). Cb MN A(B) BAT C closed in Deorbit and Entry Vehicle Preparation, 14.1.

SCS HYBRID DEORBIT THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP				
-10:00		MN BUS TIE BAT A/C - on (up) Verify bat bus A current incr &/or bat voltage decr MN BUS TIE BAT B/C - on (up) Verify bat bus B current incr &/or bat voltage decr	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line if cb MNA & B BAT C (2) - open, or three batteries on line for deorbit and entry if cbs closed (panel 275).
-05:00				
AC	6	Check boresight star		
	7	For X-axis thrust ΔV Setup, 7.6.2		If G&N inoperative, X axis only direction ΔV can be measured.
CP	8	If P47 for thrust monitor Key V37E 47E	2	G&N monitoring desirable but not required. Refer to 8.1.6 for P47 description.
		Poss PROG alarm (8.1.16)		R02.
		FL V16 N83 ΔVX, Y, Z (cont) XXXX.X FPS		
		If desired Key N62E VI XXXXX. FPS H dot XXXXX. FPS H pad XXXX.X NM		Inertial velocity. Altitude rate. Altitude above launch pad radius.
		KEY REL (to return to N83)		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
-00:30				
AC, CP	9	RHC (both) - ARMED	2	
AC		THC - ARMED		
		ATT DBD - MIN	1	
		LIM CYCLE - OFF		
DP		UP TLM CMD - RSET then NORM	3	
		PCM BIT RATE - HI		
		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
00:00				
	10	Perform SM RCS thrust Mon ΔV ind or EVNT TMR ind		
	11	SM RCS thrust complete EMS MODE - STBY		6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
		Rcd ΔV ind, EVNT TMR ind		
	12	Sel SCS Att Cont mode, 7.1		
	13	Perform Sep, 14.2		Separation at SM deorbit attitude saves time. Only one minute allowed between burns.
	14	Mnvr to CM RCS deorbit att R_____°, P_____°, Y_____°	2	Both CM RCS systems should be enabled. CM RCS portion completed with +X axis ≈70° below velocity vector (apex down and forward); ≈110° +pitch maneuver from heads down, BEF, SM RCS portion of deorbit.
		Verify using external visual cues		
		MAN ATT ROLL, YAW - RATE CMD	1	
		MAN ATT PITCH - ACCEL CMD		
		RATE - HI		
		FDAI SCALE - 5/5		

SCS HYBRID DEORBIT THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	15	EVNT TMR ind - SM RCS C/O +2 min EMS MODE - NORM	1	Two minutes after SM RCS cutoff, start CM RCS burn. 6.1.1, note 10.
CP AC		RHC 1 - contin -pitch RHC 2 - pulse +pitch to maintain att in 3 axes	2 1	Negative pitch jets have ≈25 to 30% less authority than positive jets because of jet location and thrust direction relative to CM c.g.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If only 1 RHC Pulse RHC + & - 5° from pitch retro att, maintaining rates <3°/sec xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	16	Mon ΔV ind or EVNT TMR ind for req value		ΔV indicator cutoff cue must be adjusted to account for EMS sensing axis (along X) being reversed from SM RCS burn and biased off ≈70° from CM RCS velocity vector. (ΔVems = ΔVcm Cos 70°).
	17	Term CM RCS deorbit burn MAN ATT (3) - RATE CMD or ACCEL CMD EMS MODE - STBY Rcd ΔV ind THC - LOCKED		6.1.1, note 10.
	18	Set up for CM RCS Sys 1 AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (6) - MNA or MNB AUTO RCS CM 2 (6) - OFF	8	Electrically isolates system 2 for entry. If a problem develops in system 1, disable affected channel and use direct RCS control.
CP	19	PRO (exit P47)	2	
	20	FL V37 Key XXE Go to SCS Entry, 14.4		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	13.0 ALIGNMENTS		For general G&C operating data, refer to operating notes, 6.1.
	13.1 G&N ALIGNMENTS		
	13.1.1 (P50) Soyuz Orientation Determination		Computes matrix describing relative orientation between CSM and Soyuz. Option 2 may not be usable if Soyuz does not have a star tracker.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2		Options 1 and 2. Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
AC	CMC ATT - IMU (verify) LOGIC 2/3 PWR - on (up)	1 7	Required for control and display functions if SCS - on option not selected.
	Opt - on (req), 8.1.4 Att Cont (req), 7.1		Options 1 and 2. Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
	Soyuz - solar inertial (req) Soyuz star tracker - locked on celestial body (req)		Options 1 and 2. Option 2. Assumes Soyuz has a star tracker.
CP 1	Key V37E 50E FL V04 N06 00012 (ref option) 0000X (desired option)		CMC initializes R2 = 00001.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	(X = 1, 2, or 3)		Reference options are as follows: R2 = 00001 - Soyuz sun sensor, IMU 00002 - IMU, Soyuz sun sensor & star tracker 00003 - Soyuz angles from independent source
	Accept PRO Option 1 or 2, go to 2 Option 3, go to 7 Reject Key V22E Load desired option	2,140	CMC computes present NB to Soyuz matrix as desired IMU orientation.
	Poss PROG alarm		R02 (8.1.15).
	(R53 - Sighting Mark Routine)		
2	FL V51 (please mrk) MARK	122	
	If option 2 Record star tkr angles at time of MARK for input to N14		
	To terminate Key V37E XXE	2,140	
	or Key V34E FL V37 Key XXE		

(P50) SOYUZ ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb) When mrking complete Reselect ext verb		Alarm generated if mark system busy or if extended verb active.
3	FL V50 N25 00016 (term mrks) Accept PRO Opt 1, go to 7 Opt 2, go to 4 Reject MARK REJ, return to 2	2,140	Due to coding, noun and R1 not blanked on recycle.
4	FL V01 N71 Trgt code OOCDE Accept PRO		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker DE - Target (celestial body) codes: 00 - Planet (any planet except earth) 01 to 45 - Star 46 - Sun 47 - Earth
	Poss OPR ERR Recycles disp		Target code negative, >47 or if C = 1 and CDE ≠ 146.
	Reject Key V21E Load desired data		

NORMAL-BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	FL V06 N14 (tracker angles) OGA XXXXX. ARC MIN IGA XXXXX. ARC MIN Poss OPR ERR (recycles N14) Accept PRO Reject Key V24E Load desired tracker angles	2,140	Tracker azimuth. Tracker elevation. If N14 (R1 or R2) >180°.
	6	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data		This flash will occur only if marks were made on a planet. X, Y, Z - components of planet unit position vector at present time. Use on-board tables to determine planet position vector at present time.
	7	FL V06 N23 R, P, Y (NB to Soyuz ang) XXX.XX DEG Accept PRO Reject Key V25E Load desired data		Gimbal angles based upon CSM body axes and desired orientation.
	8	FL V37 Key XXE		
	9	Opt Pwr Down, 8.1.4		

(P50) SOYUZ ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	13.1.2 (P51/P53) IMU Orientation Determination		(P51) IMU Orientation Determination defines inertial orientation of IMU using optics, Soyuz sun sensor, or star tracker. (P53) Alternate LOS IMU Orientation Determination defines inertial orientation of IMU using backup optical device (COAS), Soyuz sun sensor, or star tracker. P53 may also be used with failed optics or MARK pb.
	CMC - on (req), 8.1.3 ISS - on (req), 8.1.3 SCS - on (desired), 8.4.2		Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
	If Soyuz or star tkr		If Soyuz sun sensor or star tracker are to be used as source of sighting data.
	P50 - completed Soyuz - solar inertial (req)		If valid transformation not previously established via P50.
CDR	CMC ATT - IMU (verify)	1	
	LOGIC 2/3 PWR - on (up)	7	Required for control and display functions if SCS - on option not selected.
	Opt - on (req, P51), 8.1.4 COAS - calib (req, P53), 13.1.8		Optics required for P51; COAS used for P53.
	Att Cont (req), 7.1		Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
	Total Att Disp (req), 7.2.5		Both ISS and GDC attitude displays recommended for monitoring of IMU coarse align and SC motion.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	1	Key V37E 51E/53E	2,140	
		Poss PROG alarm FL V37 Key V05 N09E (to verify alarm) 00210 (ISS not on) Perform ISS turnon Key 51E/53E		R02 not entered in P51/P53.
	2	FL V50 N25 00015 (trgt acq)	2,140	Targets (celestial bodies).
		a. Desired att cont mode, 7.1 Mnvr to acq tgts, if necessary PRO If P51 go to 3 If P53 go to 4		V16 N20 may be keyed in to monitor for impending gimbal lock if operating from LEB where no FDAI available.
	or	b. To coarse align IMU to SC axes ENTR (when att acpt) V41 N22 (coarse align) R, P, Y 000.00 DEG NO ATT lt - on, then out Recycle 2 (R53, Sighting Mark Routine)		Time and RCS fuel may be saved and subsequent IMU alignment decisions greatly simplified if IMU left inertially stabilized as close as possible to orientation required for future CMC programs.
	3	FL V51 (please mrk) OPT ZERO - OFF OPT MODE - MAN	122	Not necessary for Soyuz sun sensor.

(P51/P53) IMU ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Ctr trgt in SXT MARK (on trgt), go to 6		SCT may be used if reduced accuracy acceptable. MARK REJ with no marks produces 00110 alarm. PRO recycles FLV51. If star tracker used, record star tracker angles at time of MARK for input to N14.
	To terminate Key V37E XXE		
	or Key V34E FL V37 Key XXE		
	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb)	2,140	Alarm generated if mark system busy or if extended verb active.
	When mrking complete Reselect ext verb		
	(R56, Alternate LOS Sighting Mark Routine)		To perform sighting marks using COAS.
4	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG		
	Accept PRO Reject Key V24E Load desired SA & TA		Values obtained from COAS Calibration, 13.1.8. Nominal SA and TA for COAS sightings are: SA - 000.00 DEG TA - 57.470 DEG

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	FL V53 (please mrk) RHC - ctr trgt in COAS reticle ENTR, go to 6		SCS minimum impulse mode is recommended. CMC interprets ENTR as a mark. An inadvertent PRO instead of ENTR will recycle FL V53. If star tracker used, record star tracker angles at time of MARK for input to N14.
	6	FL V50 N25 00016 (term mrks) Accept PRO Reject If P51, MARK REJ pb - push Return to 3	2,140 122	An unsatisfactory mark may be rejected by pressing MARK REJ pushbutton (P51) or ENTR (P53) anytime prior to terminating marking sequence. In P51, possible program alarms if marks rejected without prior marks or if surplus marks made. In P51, due to coding, noun and R1 not blanked on recycle.
		If P53, ENTR, return to 5	2,140	CMC interprets ENTR as a mark reject.
	7	FL V01 N71 Trgt code 00CDE Accept PRO		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker DE target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth

(P51/P53) IMU ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss OPR ERR Recycles disp		Target code negative, >47, or C = 1 & CDE ≠ 146.
	Reject Key V21E Load trgt code		
	If C = 0 or 1 & DE ≠ 00 For trgt 2 P51, return to 3 P53, return to 4		
	After 2nd pass Go to 10		
	If C = 0 or 1 & DE = 0, go to 9		
	If C = 2, go to 8		
8	FL V06 N14 (tracker angles)	2,140	
	OGA XXXXX. ARC MIN		
	IGA XXXXX. ARC MIN		
	Accept PRO Reject Key V24E Load desired tracker angles		
	For trgt 2 (DE ≠ 00) Return to 3 After 2nd pass, go to 10		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	9	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data For trgt 2 P51, return to 3 P53, return to 4 (R54, Sighting Data Display Routine)		This flash will occur only if marks were made on a planet. X, Y, Z - components of planet unit position vector at present time. Use on-board tables to determine planet position vector at present time. Tests accuracy of pair of target sightings.
	10	FL V06 N05 Sighting angle diff XXX.XX DEG Sighting angle XXX.XX DEG Accept PRO Reject Key V32E, return to 2	2,140	CMC calculates and stores IMU orientation as REFSMMAT.
	11	FL V37 Key XXE		R00.
	12	If P51 and no P52 Opt Pwr Down, 8.1.4		

(P51/P53) IMU ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	13.1.3 (P52/P54) IMU Realign		(P52) IMU Realign, and (P54) Alternate LOS IMU Realign, aligns IMU from known orientation to one of three orientations selected by crew. Sightings made on two targets (celestial bodies) with optics, Soyuz sun sensor, or star tracker in P52, or with COAS, Soyuz sun sensor, or star tracker in P54. Provides option for automatically pulse torquing gyros to prevent gimbal lock problem during plane change burn (NPC sequence). Orientation options available are: o Preferred o Nominal o REFSMMAT
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2		Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
	If Soyuz or star tkr		If Soyuz sun sensor or star tracker are to be used as source of sighting data.
	P50 - completed ATM - solar inertial (req)		If valid transformation not previously established via P50.
CDR	CMC ATT - IMU (verify) LOGIC 2/3 PWR - on (up)	1 7	Required for control and display functions if SCS - on option not selected.
	Optics - on (req, P52), 8.1.4 COAS - calib (req, P54), 13.1.8		Optics required for P52; COAS used for P54.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Att Cont (req), 7.1		Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
	DAP - Load & activate (req), 8.2.1 or 2		R03 or R04.
	Tot Att Disp (req), 7.2.5		Both ISS and GDC attitude displays recommended for monitoring of IMU coarse align and SC motion.
CP 1	If MINKEY auto call Go to 4	2,140	P52 automatically called by MINKFY controller for pulse torquing during NPC sequence.
or	Key V37E 52E/54E Go to 2		
	Poss PROG alarm		R02 (8.1.15).
2	FL V04 N06		If preferred orientation defined, R2 = 00001. Otherwise R2 = 00003 (REFSMMAT alignment).
	Option code 00001 Option 0000X		Options available are: 00001 - Preferred (operator ensures preferred orientation defined) 00002 - Nominal 00003 - REFSMMAT
	Accept PRO Reject Key V22E Load desired option		
	a. If 00001, go to 4		
or	b. If 00002, go to 3		
or	c. If 00003, go to 8		
3	FL V06 N34 GET align 00XXX. HRS 000XX. MIN 0XX.XX SEC		GET align - Time at which nominal orientation defined. Display initially 0, 0, 0. If this value accepted, nominal orientation will be defined for GET align automatically selected as present time.

(P52/P54) IMU ALIGN

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO	2,140	
	Reject Key V25E Load desired GET align		
4	FL V06 N22 R, P, Y XXX.XX DEG		
	Accept PRO, go to 6		
	or If P52 plane change PRO, go to 5		Occurs when P52 automatically called for plane change torquing.
	Reject Desired att control mode, 7.1 Mnvr SC Key V32E		To obtain acceptable MGA. V32E recycles to update gimbal angle display.
	or Key V37E XXE Exit P52/P54		
5	FL V50 N25 00020 (perform NPC torquing)		Allows option to bypass pulse torquing.
	Accept CMC MODE - FREE		Prevents jet firing (SC rotation) during gyro torquing.
	PRO		If PRO (pulse torquing) done prior to burn, must key PRO (to establish original alignment) after burn (PCFLAG is reset on exit from P52).
	V16 N20 (present gmbl angles) R, P, Y XXX.XX DEG		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	NPC torque (preburn) exit P52, go to 12.2.1/12.2.2		CMC computes and torques gyros for NPC burn.
	NPC torque (postburn) exit P52		
	Reject ENTR	2,140	Controller selects P41 for burn. Do not ENTR if first pulse torquing done and this is second pass.
	Poss PROG alarm Key V05 N09E (to verify alarm) 00402 (honor 2nd NPC torque request) KEY REL Recycle 5		If first pulse torquing done, PCFLAG reset on exit from P52 making it imperative that second pulse torquing be done.
6	FL V50 N25 00013 (coarse align or pulse torque)		
	Coarse align PRO, go to 7		Selects coarse align R50 and allows auto optics positioning.
	Pulse torque ENTR		To pulse torque gyros. Bypasses R50 and auto optics positioning.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	V16 N20 (present gmbl angles) R, P, Y XXX.XX DEG	2,140	If it appears that IMU will be torqued into gimbal lock, maneuver should be performed to avoid condition. If SC CONT at CMC and CMC MODE at AUTO or HOLD, the DAP will maneuver vehicle to follow platform as it moves. If N93 used for display, scaling of N93 will not remain XX.XXX. Initially, N93 will display proper values; thereafter, R2, then R3, and finally R1 will diminish to zero as each gyro axis is torqued.
	Go to 21 (R50, Coarse Align Routine)		During coarse alignment, if SC CONT at CMC and CMC MODE at AUTO or HOLD, DAP will maneuver vehicle to follow platform as it moves.
7	Verify coarse align complete NO ATT lt - on, then out Mon ball motion		If required gimbal angle change <1 degree, IMU will not be coarse-aligned.
8	FL V50 N25 00015 (trgt acq)		
	a. For CMC assist in sel Desired att cont mode, 7.1 Mnvr to acq trgt		After target acquisition, SCS minimum impulse operation desirable for minimum fuel consumption and reduction of vehicle rates to minimum.
	PRO		CMC performs target selection routine. However, for P54, since primary optics are not being used, selected stars may not be acceptable for backup optics sightings.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss FL V05 N09 00405 (accept pair not avail) Mnvr until suitable trgt acq PRO, go to 9	2,140	
	or Key V32E, recycle 8		
or b.	To bypass CMC sel ENTR		Crew manually acquires target.
9	FL V01 N70 Trgt code OOCDE		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker
	Accept If P52 & C = 0 OPT ZERO - OFF	122	
	OPT MODE - as desired PRO	2,140	DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth
	If P52 & C ≠ 0 (or P54) PRO		
	Poss CPR ERR Recycles disp		Target code negative, >47 or if C = 1 and CDE ≠ 146.
	Reject Key V21E Load desired code		

(P52/P54) IMU REALIGN

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	For P52 If C = 0 & DE ≠ 00 & OPT MODE - CMC, go to 11	122	
	or OPT MODE - MAN, go to 12		
	If C ≠ 0 & DE ≠ 00, go to 12		
	For P54 If DE ≠ 00, go to 13		
10	FL V06 N88 (planet only) X, Y, Z .XXXXX	2,140	X, Y, Z - Components of planet unit position vector at present time.
	Accept If P52 PRO		
	If OPT MODE - MAN or C ≠ 0, go to 12	122	
	If P54 PRO, go to 13	2,140	
	Reject Key V25E Load desired data		Use on-board tables to determine planet position at present time.
	(R52, Auto Optics Positioning)		Points SLOS of optics at selected target.
11	V06 N92 (desired opt angles) SA XXX.XX DEG TA XX.XXX DEG		Optics will drive to acquire selected target. No display if R52 reselected after R53 called.
	Poss FL V05 N09 (2 sec priority) 00404 (TA >90°)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	a. Desired att cont mode, 7.1		
	Mnvr to reduce TA		If required optics angles not being displayed, key V16 N92E to obtain display.
	PRO	2,140	
	or b. Key V34E FL V37 Key XXE		R00.
	If TA >50° & <90° Desired att cont mode, 7.1		If TA >50° and <90°, trunnion driven to upper limit (±49.7754°) and held at this angle.
	Mnvr to reduce TA		If required optics angles not being displayed, key V16 N92E to obtain display.
	When sighting mrks are desired OPT MODE - MAN	122	Calls R53. To regain auto optics positioning, select OPT MODE - CMC (prior to completion of R53).
	(R53, Sighting Mark Routine)		
12	FL V51 (please mark) Ctr trgt in SXT	2,140	SCT may be used if reduced accuracy acceptable.
	MARK (on trgt), go to 15	122	If star tracker used, record star tracker angles at time of MARK for input to N14.
	To terminate Key V37E XXE	2,140	
	or Key V34E FL V37 Key XXE		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb) When mrking complete Reselect ext verb	2,140	Alarm generated if mark system busy or if extended verb active.
	(R56, Alternate LOS Sighting Mark Routine)		To perform sighting marks using COAS.
13	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG Accept PRO Reject Key V24E Load desired SA & TA		Values obtained from COAS Calibration, 13.1.8. Nominal SA and TA for COAS sightings are: SA - 000.00 DEG TA - 57.470 DEG
14	FL V53 (please mrk) RHC - ctr trgt in COAS reticle ENTR		SCS minimum impulse mode recommended. CMC interprets ENTR as a mark. An inadvertent PRO instead of ENTR will recycle FL V53. If star tracker used, record star tracker angles at time of MARK for input to N14.
15	FL V50 N25 00016 (term mrks)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO Reject If P52, MARK REJ pb - push, return to 12 If P54, ENTR, return to 14	2,140	An unsatisfactory mark may be rejected by keying MARK REJ pushbutton (P52) or ENTR (P54) anytime prior to terminating marking sequence. In P52, possible program alarms if marks rejected without prior marks or if surplus marks made. In P52, due to coding, noun and R1 not blanked on recycle.
16	FL V01 N71 Trgt code 00CDE Accept PRO Poss OPR ERR Recycles disp Reject Key V21E Load trgt code If C = 0 or 1 & DE ≠ 00 For trgt 2 Return to 9 If C = 2, go to 17		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth Target code negative, >47 or if C = 1 and CDE ≠ 146.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	17	FL V06 N14 (tracker angles) OGA XXXXX. ARC MIN IGA XXXXX. ARC MIN Accept PRO Reject Key V24E Load desired tracker angles For trgt 2 (DE ≠ 00) Return to 9	2,140	
	18	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data For trgt 2 Return to 9 (R54, Sighting Data Display Routine)		This flash will occur only if marks are made on a planet. X, Y, Z - Components of planet unit position vector at present time. Use on-board tables to determine planet position vector at present time. Test accuracy of pair of target sightings.
	19	FL V06 N05 Sighting angle diff XXX.XX DEG Sighting angle XXX.XX DEG Accept PRO Reject Key V32E, go to 21		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R55, Gyro Torquing Routine)		Calculates and displays gyro torquing angles for final (fine) alignment of inertial platform and to torque gyros.
CP	20	FL V06 N93 (Δ gyro angles) X, Y, Z XX.XXX DEG	2,140	X, Y, Z Gyro - Angle through which each gyro must be torqued to obtain desired orientation. Once this step is complete, CMC will reset preferred orientation flag. If SC CONT at CMC and CMC MODE switch is at AUTO or HOLD during R55, DAP will maneuver CSM to follow platform as it moves.
		Accept CMC MODE - FREE PRO (gyros torqued)		Pulse IRIGS through desired angle.
		Reject V32E, go to 21		Do not torque gyros.
		or Key V37E 00E, go to 23		
	21	FL V50 N25 00014 (fine align check)		
		Accept PRO, return to 8		PRO repeats target sightings (R52 & R53) for P52; (R56) for P54; sighting data test (R54), and gyro torquing (R55) to verify accuracy of alignment.
		Reject ENTR		
	22	FL V37 Key XXE		ROO.
	23	If P52 Opt Pwr Down, 8.1.4		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	13.1.4	(P55) Soyuz Star Tracker Gimbal Angle Program		Computes and displays Soyuz star tracker gimbal angles required to acquire a specified star. This program may not be usable on ASTP if the Soyuz does not have a star tracker.
		CMC - on (req), 8.1.3		
		ISS - on & orient known (req), 8.1.3 & sec 13		Option 1.
		SCS - on (desired), 8.4.2		Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
		P50 - completed		Operation of P55 assumes P50 previously selected to establish required relative orientation matrix.
AC		CMC ATT - IMU (verify)	1	
		LOGIC 2/3 PWR - on (up)	7	Required for control and display functions if SCS - on option not selected.
		Opt - on (req), 8.1.4		Option 2.
		Att Cont (req), 7.1		Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
		Soyuz - solar inertial (req)		Option 2.
CP	1	Key V37E 55E		
	2	FL V04 N06 00013 (ref option) 0000X (desired option)		CMC initializes R2 = 00001.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	(X = 1 or 2)		Reference options are as follows: R2 = 00001 - IMU. 00002 - Optics and Soyuz sun sensor.
	Accept PRO Option 1, go to 7 Option 2, go to 3	2,140	
	Reject Key V22E Load desired option		CMC initializes N70/N71 star code to 46 (sun).
	If option 1 Poss PROG alarm		R02 (8.1.15).
	(R53 - Sighting Mark Routine)		
3	FL V51 (please mrk) OPT ZERO - OFF OPT MODE - MAN Ctr trgt in SXT	122	Required for centering target using OHC. SCT may be used if reduced accuracy acceptable.
	MARK (on trgt)		MARK REJ with no marks produces 00110 alarm. PRO recycles FLV51.
	To terminate Key V37E XXE	2,140	
	or Key V34E FL V37 Key XXE		

(P55) SOYUZ STAR TRACKER GIMBAL ANGLE PROGRAM

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb) When mrking complete Reselect ext verb	2,140	Alarm generated if mark system busy or if extended verb active.
4	FL V50 N25 00016 (term mrks) Accept PRO Reject MARK REJ, return to 3		Due to coding, noun and R1 not blanked on recycle.
5	FL V01 N71 Trgt code OOCDE Accept PRO DE ≠ 00, go to 7 C = 2, go to 9 Poss OPR ERR Recycles disp		CMC initializes C to 0 (optics) and DE to 46 (sun). C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor (not significant for P55) 2 - Soyuz star tracker (not significant for P55) DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth Target code negative, >47 or if C = 1 and CDE ≠ 146.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V21E Load trgt code	2,140	
	6	FL V06 N88 (planet only) X, Y, Z . .XXXXX Accept PRO Reject Key V25E Load desired data		This flash will occur only if marks were made on a planet. X, Y, Z - Components of planet unit position vector at present time. Use on-board tables to determine planet position vector at present time.
	7	FL V01 N70 Trgt code 00CDE Accept PRO DE ≠ 00, go to 9 Reject Key V21E Load trgt code Poss PROG alarm Key V05 N09E (to verify alarm) 00107 (excessive tracker angles) Poss OPR ERR Recycles disp		Source code C must be zero. Any non-zero digit turns on OPR ERR lt. C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor (not significant for P55) 2 - Soyuz star tracker (not significant for P55) DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth Target code negative, >47 or C ≠ 0.
	8	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data		

(P55) SOYUZ STAR TRACKER CENTAL ANGLE PROGRAM

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 00107 (excessive tracker angles)	2,140	
9	FL V06 N14 (tracker angles) OGA XXXXX. ARC MIN IGA XXXXX. ARC MIN Accept PRO Reject Key V32E, return to 7		
10	FL V04 N19 OGA OSABC IGA OODEO Accept PRO Reject Key V32E, return to 7		Tracker azimuth: S - sign (0 = positive, 1 = negative) ABCDE - absolute value (octal equivalent of R1 of N14).
11	FL V37 Key XXE		
12	Opt Pwr Down, 8.1.4		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.1.5 (V40) Zero ICDU Extended Verb		o Ensures synchronization between ISS CDU counters and CDU counters in CMC.
		CMC - on (req), 8.1.3 ISS - on (req), 8.1.3		o Terminates IMU coarse align mode and enters fine align mode (inertial IMU).
CP	1	Key V40E NO ATT lt - OFF Wait 15 sec	2,140	
		Poss OPR ERR		If IMU stall routine in use.
		Poss PROG alarm Exit routine Key V05 N09E (to verify alarm) 00206 (zero encode not allowed) Key V41 N20E, 13.1.6		If ISS in coarse align mode with gimbal lock.

(V40) ZERO ICDU EXTENDED VERB

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	13.1.6	(V41 N20) Coarse Align ICDU Extended Verb		Coarse aligns IMU to gimbal angles specified by crew.
		CMC - on (req), 8.1.3 ISS - on (req), 8.1.3		
CP	1	Key V41 N20E	2,140	
		Poss OPR ERR Exit coarse align		Occurs if another extended verb active.
	2	FL V21 N22 (new ICDU angles) R, P, Y XXX.XX DEG		Registers initially blank.
		Load desired angles		
	or	Key V33E		6.1.3, note 3m.
		DSKY - V41 NO ATT lt - on		NO ATT lt will remain on even after gimbals have been driven to specified angles.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00211 (error >2°)		Present and specified gimbal angles may be compared by keying V16 N20E and V16 N22E. Alternate method is to key V62E (Mode 2) to display difference between N20 and N22 on FDAI error needles.
		To recover from PROG alarm Key V41 N20E		If IMU stall routine in use.
		Poss OPR ERR Exit coarse align		
	3	To extinguish NO ATT lt & term coarse align Key V40E Wait 15 sec		Zero ICDU extended verb, 13.1.5.
		or V42E		Torque gyros extended verb, 8.3.2.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.1.7 (V41 N91) Coarse Align OCDU Extended Verb		Drive optics to shaft and trunnion angles specified by crew. Not permitted from start of drive test until end of burn. (Ref note opposite 00117 alarm, step 3.)
		CMC - on (req), 8.1.3 Opt Pwr Up (req), 8.1.4		
CP	1	Key V37E 00E	2,140	V41 N91 from P00 only.
	2	OPT ZERO - OFF OPT MODE - CMC	122	
	3	Key V41 N91E	2,140	
		Poss OPR ERR Exit coarse align OCDUs		Occurs if another extended verb active.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00115 (OPT MODE not CMC) OPT MODE - CMC	122	OPR ERR lt on.
		or 00117 (V41 N91 not avail) Exit coarse align	2,140	This alarm code indicates that OCDUs are being used by TVC DAP or gimbal drive test and that this procedure cannot be performed. May occur from start of drive test until end of burn (not expected since V41 N91 is restricted to P00).
	4	FL V21 N92 (new OCDU angles) SA XXX.XX DEG TA XX.XXX DEG		Registers initially blank.
		Load desired SA & TA		
	or	Key V33E		6.1.3, note 3m.
	5	DSKY - V41		Key V16 N91E to monitor optics angles.
	6	Opt Pwr Down, 8.1.4		

(V41 N91) COARSE ALIGN OCDU EXTENDED VERB

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.1.8 Inflight COAS Calibration		Provides method for in-flight calibration of COAS (i.e., equivalent shaft and trunnion angles). Spare COAS light bulbs (2) are stowed in volume U3. When installing COAS on window mount, align (rotate COAS barrel to detent) as indicated by arrow on decal.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 6.4.2		
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify) COAS installed COAS PWR - on (up)	1 15	6.1.1, note 15.
		COAS filter installed (req)		Filter used to reduce glare of reticle image when sighting on low intensity targets.
	1	Opt Pwr Up, 8.1.4		
	2	Sel Tot Att Disp, 7.2.5		
CP	3	Key V37E 52E	2,140	
		Poss PROG alarm		R02 (8.1.15).
	4	FL V04 N06		
		Option code 00001		If preferred alignment flag is set, R2 will display 00001. Otherwise, R2 will display 00003 (REFSMMAT alignment).
		Option 0000X		Options available are: 00001 - Preferred (operator ensures preferred orientation defined) 00002 - Nominal 00003 - REFSMMAT
		Sel REFSMMAT orient (V22E, 3E) PRO		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	FL V50 N25 00015 (trgt acq) Att Cont Mode, 7.1 Mnvr to acq trgt in COAS ENTR	2,140	Target (celestial bodies).
	6	FL V01 N70 Trgt code 00CDE OPT ZERO - OFF OPT MODE - CMC	122	C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker
		Reject Key V21E Load trgt code of trgt centered in COAS Accept PRO	2,140	DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth
		Poss OPR ERR Recycles display		Target code negative, >47, or if C = 1 and CDE ≠ 146.
		If trgt not a planet, go to 8		
	7	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data		X, Y, Z - Components of planet unit position vector at present time.

INFLIGHT COAS CALIBRATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R52, Auto Optics Positioning Routine)		
CP	8	V06 N92	2,140	Display will be updated every ≈0.5 second.
		SA XXX.XX DEG		
		TA XX.XXX DEG		
		When trgt centered in COAS & SA & TA relatively constant Key VERB (to freeze disp)		
		Accept Rcd SA & TA for use in P20/P53/P54		
		Reject KEY REL Repeat 8		
	9	Opt Pwr Down, 8.1.4		
AC		COAS PWR - OFF	15	
	10	Sel new prog		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.2 SCS ALIGNMENTS		
		13.2.1 Alternate SC Inertial Attitude Determination and GDC Alignment		
AC		SCS - on (req), 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
	1	Opt Pwr Up, 8.1.4		
	2	Sel Tot Att, Att Err & Rate Disp for SCS, 7.2		If IMU off, only FDAI 1 need be powered or selected.
	3	Sel SCS Att Hold/Rate Cmd, 7.1.4		For fuel conservation, max deadband preferred until stars obtained.
CP	4	Obtain 2 stars in SCT Sel Opt Cont, 7.5.2 OHC - ctr star on R-line OHC - ctr star in FOV Hold star 1 in ctr of FOV Hold star 2 on R line	121	 OHC - Optics hand control. Final adjustment required OPT COUPLING - DIRECT. Minimum impulse control can be used to allow positioning of stars on R line.
AC	5	BMAG MODE (3) - RATE 2 ATT DBD - MIN BMAG MODE (3) - ATT 1/RATE 2	1	Stars must be kept aligned while BMAGs caged.
CP	6	Read & rcd angles on trun & shft ind(s) & xmit with star data to STDN	121	

ALTERNATE SC INERTIAL ATTITUDE DETERMINATION AND GDC ALIGNMENT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	7	Obtain inertial att values for ATT SET tw from STDN	121	
	8	Align GDC to STDN values, 7.3		
	9	Opt Pwr Down, 8.1.4		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.2.2 Inplane GDC Alignment		Provides method for aligning SCS attitude reference system in orbital plane (+Y axis of reference along V x R). This allows use of ORDEAL on FDAI 2 with IMU out of plane.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		
AC		CMC ATT - IMU (verify)	1	
	1	Sel Tot Att Disp, 7.2.5 FDAI SEL - 1/2		
CP	2	Key V37E 52E	2,140	
		Poss PROG alarm		R02 (8.1.15).
	3	FL V04 N06 Option code 00001 Option 0000X		Options available are: 00001 - Preferred (operator ensures preferred orientation defined) 00002 - Nominal 00003 - REFSMMAT
		Select nom option Key V22E 2E		
		PRO		
	4	FL V06 N34 GET align 00XXX. HRS 000XX. MIN 0XX.XX SEC		GET align - Time at which vehicle position and velocity vectors selected to define IMU local vertical orientation.

INPLANE GDC ALIGNMENT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Key V25E Load present time plus 10 min	2,140	
	5	Establish Att Cont, 7.1 Damp veh rates PRO		Selected to prevent drift between gimbal angle calculation and GDC alignment.
	6	FL V06 N22 R, P, Y XXX.XX DEG		IMU gimbal angles for desired IMU orientation at present SC attitude.
AC	7	ATT SEL tw - adj to Euler angles disp on DSKY	1	
	8	Align GDC, 7.3		
	9	Sel new program		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.2.3 Backup GDC Alignment With COAS		Aligns GDC without IMU, CMC or optics.
		SCS - on (req), 8.4.2 CMC - off or STBY (req)		A more accurate alignment can be performed if COAS calibration procedure, 13.1.8, has been performed earlier and calibration information provided to STDN for use in computation of R, P and Y ALIGN.
		COAS - installed		6.1.1, note 15.
AC		COAS PWR - on (up)	15	
		.05 G sw - OFF (verify)	1	
		CMC ATT - IMU (verify)		
CP	1	Rcd following data from STDN GDC Align Values (step 2) R ALIGN ____, P ALIGN ____ Y ALIGN ____		
		Boresight star data (step 13) Boresight star SPA ____° SXP ____°		SPA - Sight pitch angle SXP - Star X position
		Nav stars Prim star ____ (step 5) Sec star ____ (step 8) Star diff angle ____° (step 7)		Star difference angle cannot exceed 35° since this is maximum COAS field of view in pitch.
	2	SCS att set for FDAI 1, 7.2.4		
AC		ATT SET tw - set R, P, Y ALIGN		
	3	Set reticle to 0° pitch		

BACKUP GDC ALIGNMENT WITH COAS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	4	Sel SCS att cont mode, 7.1		
	5	Mnvr to posi ion prim star on crosshairs of COAS reticle		
	6	Establish att hold with min P & Y dbd		
	7	Pitch COAS reticle up Star Angle Diff value		
	8	Roll SC to place sec star on pitch axis of COAS reticle		
	9	Establish att hold with min roll dbd		
	10	Repeat 3 through 9 as necessary		
	11	Align GDC, 7.3 GDC ALIGN pb - push, when stars positioned, until err null on FDAI 1	1	
	12	Mnvr to ΔV att ATT SET tw - set to ΔV att Mnvr Null errors on FDAI		
	13	Perform Boresight Star ck		
	14	COAS PWR - OFF	15	

13.2.3 BACKUP GDC ALIGNMENT WITH COAS

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.3 G&C ALIGNMENTS		
		13.3.1 Backup GDC and/or IMU Alignment		Aligns GDC and/or IMU without CMC.
		SCS - on (req), 8.4.2		
		CMC - off or STBY (for step 3a)		
		COAS installed		6.1.1, note 15.
AC		COAS PWR - on (up)	15	
		.05 G sw - OFF (verify)	1	
		CMC ATT - IMU (verify)		
CP	1	Rcd following data from STDN		
		GDC Align Values (step 8)		
		R ALIGN_____, P ALIGN_____,		
		Y ALIGN_____		
		SXTS data (step 10)		SXTS - Sextant star.
		SXTS_____		
		SHAFT_____°		
		TRUN_____°		
		Boresight star data (step 4)		
		Boresight star_____		
		SPA_____°		SPA - Sight pitch angle.
		SXP_____°		SXP - Star X position.
				0° and 0° allows SC to be rolled about boresight star in 7.
		Nav stars (step 7)		
		Prim star_____(0° mark on R line of SCT reticle)		
		Sec star_____(R line)		

BACKUP GDC AND/OR IMU ALIGNMENT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	ISS att set for FDAI 1, 7.2.4		
	3	Cage IMU		This step is bypassed, if only GDC aligned.
		If IMU in stby IMU PWR - on (up) (IMU automatically cages)	100	Guarded. Occurs only if CMC off, or in STBY.
		If IMU powered up		
		a. IMU PWR - OFF Wait 5 min for gyros to run down IMU PWR - on (up)		Guarded. Guarded.
AC	or	b. ATT SET tw - set to 0°, 0°, 0° Mnvr SC to 0°, 0°, 0° & null FDAI 1 errors	1	IMU gimbal angles should be 0±5° before caging to avoid damaging gyros.
		IMU CAGE - on (up) & hold until 11		Guarded.
	4	Sel desired SCS Att Cont Mode, 7.1, & mnvr to position boresight star in COAS		
	5	Opt Pwr Up, 8.1.4		
CP	6	Set opt to 0° shft & 352.5° trun, 7.5		0° shaft and 352.5° trunnion places 0° mark of SCT reticle along +Zsc axis.
		OPT PWR - OFF	100	Eliminates optics drift.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	7	Mnvr to position stars in SCT		Roll SC around boresight star to acquire navigation stars. After positioning primary star on 0° mark, SC may be yawed about this star to place secondary star on R line.
AC	8	Align GDC ATT SET tw - set to R, P, Y ALIGN ATT SET - GDC GDC ALIGN pb - push when stars positioned, until err null on FDAI 1	1	ELEC PWR - GDC/ECA (required for GDC ALIGN) satisfied by SCS Power Up, 8.4.2.
	9	Mnvr to ΔV att ATT SET tw - set to ΔV att Mnvr Null err on FDAI 1		
	10	Perform SXTS ck & adj SC att if necessary		With optics set to proper shaft and trunnion angles, and SC at ΔV attitude, specified star should appear in SXT.
	11	Uncage IMU IMU CAGE - on (up) and rel If 3b was used IMU CAGE - rel		This frees IMU at 0°, 0°, 0°. (For deorbit, GDC will be at 180°, 180°, 0°.)
	12	Opt Pwr Down, 8.1.4 COAS PWR - OFF	15	

BACKUP GDC AND/OR IMU ALIGNMENT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	14.0	ENTRY		For general G&C operating data, refer to operating notes, 6.1.
	14.1	DEORBIT AND ENTRY VEHICLE PREPARATION		Vehicle preparation applies to any deorbit (SPS or RCS, pure or hybrid, whether G&N, SCS or manually controlled) and should be done prior to deorbit thrust to minimize crew workload between deorbit and entry.
		(Proced in 14.1.1 thru 14.1.4 not designated as "req" are optional)		
	14.1.1	General System Management		
CP	1	SEC EVAP H2O CONT - AUTO (verify)	382	
	2	Obtain update from STDN		
DP	3	Configure TLM (req) TAPE RCDR FWD - off (ctr) PCM BIT RATE - HI UP TLM CMD - RSET, then NORM	3	After STDN dumps and rewinds tape recorder and returns DSE control to crew at last contact prior to deorbit, TAPE RCDR FWD switch placed to off (ctr) and PCM BIT RATE switch to HI.
AC	4	SECS logic check cb SECS ARM (2) - close cb ELS/CM-SM SEP (2) - close ELS LOGIC - on (up) ELS AUTO - AUTO After STDN AOS SECS LOGIC (2) - on (up) Report logic arm STDN confirm GO for PYRO ARM (as req) SECS LOGIC (2) - OFF cb SECS ARM (2) - open cb ELS/CM-SM SEP (2) - open ELS LOGIC - OFF ELS AUTO - MAN	8	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5	Propulsion Systems checks, 5.2.1 thru 5.2.3		
	6	Cryo Press - Qty & EPS DC & AC checks, 5.3.1, 5.3.3, & 5.3.4 Verify PYRO BAT A & B >31.5 vdc		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
DP		If PYRO BAT A(B) <31.5 vdc cb PYRO BUS A(B) PYRO BAT A(B) - open cb PYRO BUS A(B) BAT BUS A(B) - close	229	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	7	ECS Mon Check, 5.4.1 & Prim Gly Evap operation, 5.4.17		
	8	Sec Gly Evap operation		
CP		ECS IND sel - SEC SEC COOL PUMP - AC2 GLY DISCH PRESS - 40-52 psig SEC COOL EVAP - EVAP SEC GLY EVAP OUT TEMP - 38-50.5°F ECS IND sel - PRIM	2	
	9	Stow loose gear (req)		
	10	Dry tunl		If necessary, absorb water with towel. Condensed moisture in tunnel rains on crew during thrusting.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	11	CMC Self-Check, 8.1.8		
	12	DSKY Condition Lt Test, 8.3.1		
	13	C&WS Oper Check, 5.5.1		
	14	P52 IMU Align, 13.1.3		
	15	Verify COAS locked in stowage mount		
	14.1.2	RSI Test and Alignment		Permits testing EMS roll stability indicator (RSI) and positioning to desired orientation for entry.
AC		ELEC PWR - GDC/ECA	7	
		ATT SET - GDC	1	
	1	EMS ROLL - on (up) GDC ALIGN pb - push, hold ATT SET YAW tw - Adj thru 45° angle, observe RSI tracks ≈45°, then position RSI GDC ALIGN pb - rel EMS ROLL - OFF		Avoid FDAI gimbal lock region.
	2	ATT SET YAW tw - reset GDC ALIGN pb - push (32 sec max)		This step required only if GDC was aligned and realignment required.
	14.1.3	EMS Deorbit and Entry Test		Light illumination other than those listed indicates malfunction. ΔV/EMS SET switch slews G-V scroll and sets RNG indicator. [Lift vector up light (G >0.2) and down light (G <0.2) for entry from lunar mission only.]

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	1	Init EMS prep		
AC		EMS FUNC - OFF (verify)	1	
		cb EMS (2) - close	8	
		EMS MODE - STBY	1	
	2	EMS FUNC - EMS TEST 1 (CCW)		Test 1 checks lower trip-point of .05 G comparator.
		Wait 5 sec		
		Adj alphanumeric brightness (option)		
	3	EMS MODE - NORM		Ten seconds should be allowed to verify no malfunctions. No light on before or after 10 seconds.
		Wait 10 sec minimum		
		All ind lts - out		
		RNG ind - 0.0		
		Slew scroll until hairline superimposed on notch in next self-test pattern		EMS scroll can be slewed only one inch in reverse.
	4	EMS FUNC - EMS TEST 2 (CCW)		Test 2 checks .05 G comparator upper trip-point. No other light on before or after 10 seconds.
		.05 G lt - on		
		Wait 10 sec		
		All other lts out		
	5	EMS FUNC - EMS TEST 3 (CCW)		Test 3 checks corridor verification circuitry associated with lift vector down light.
		.05 G lt - on		
		Lift vector dn lt - on (10 sec after .05 G lt)		G <0.2.
		Set RNG ind to 58.0 NM ±0.0		RNG indicator displays minus sign for negative numbers or no sign for positive numbers in most significant digit.

EMS DEORBIT AND ENTRY TEST

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	6	EMS FUNC - EMS TEST 4 (CCW) .05 G lt - on (all others out) G-V trace (during 10 sec period) within test pattern After 10 sec, G-V trace stops at lower right corner of test pattern at ≈9 G RNG ind (during 10 sec period) counts toward zero. After 10 sec, stops at ≈0.0±0.2 NM	1	Test 4 checks range-to-go integrator circuits, range-to-go indicator, G-V servo circuits, G-V plotter.
	7	EMS FUNC - EMS TEST 5 (CCW) .05 G lt - on Lift vector up lt - on (10 sec after .05 G lt) RNG ind - 0.0 Scribe traces vert line ≈9 G to 0.28±0.1 G & stops (trace within test pattern) Align G-V scroll to entry pattern (hairline on 37K fps line)		Test 5 checks corridor verification circuitry associated with lift vector up light and enables scroll slewing to start of entry pattern. After scroll set to <37K fps, reselecting EMS TEST 5 switch position not permitted; range integrator and scroll synchronization would be lost.
	8	EMS FUNC - RNG SET (CCW) G-V traces vert line ≈0.28 G to 0.0±0.1 G & stops		
	9	EMS FUNC - Vo SET (CCW) CAUTION Never slew scroll in increase direction more than 1500 fps. Ensures range integrator remains slaved to scroll velocity.		Scroll can be slewed only one inch in reverse. In Vo SET position, both initial velocity in range integrator and scroll velocity change simultaneously.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Slew scroll until display index (arrow) aligned to predicted entry velocity	1	
	10	ΔV Test and Null Bias Check, 7.6.1		
	14.1.4	Systems Preparation		
		If suited Press Suit Circuit & PGA Check at 5.0 psia, 5.4.9		
ALL		Life vests - donned		
CP		EMEP CAB PRESS sel - OFF	351	
-1:00:00				
CP	1	CM RCS temp check SYS TEST (2) - 4B, 5B, 6B, 7B, 8B, 9B	101	Checks CM RCS 12, 14, 16, 21, 23, and 25 jet injector valve temperatures, respectively.
		If lowest reading <1.5 vdc (40°F)	8	
AC		cb CM RCS HTRS (both) - close		
		cb RCS LOGIC (2) - close		
		CM RCS LOGIC - on (up)	1	
CP		CM RCS HTRS - on (up) for 20 minutes	101	Jet injector valve direct coils utilized for preheating jets.
	2	URINE DUMP - OFF		
	3	WASTE H2O DUMP - OFF		
	4	Align RSI & GDC, 14.1.2		
	5	Set FDAI 2 on ORB RATE & restow, 8.4.8		
	6	CM RCS heating completion (if accomplished)		
-40:00		CM RCS HTRS - OFF		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	7	Configure entry bats (req)		
DP		cb MNA BAT C - close	275	
		cb MNB BAT C - close		
AC	8	Panel 8 - all cb closed (req) except	8	
		cb PL VENT FLT/PL - open		
		cb FLOAT BAG (all) - open		
		cb EDS (all) - open		
		cb CM RCS HTR (both) - open		
		cb DOCK PROBE (2) - open		
		cb SECS ARM (2) - open		
		cb ELS/CM-SM SEP (2) - open		
	9	Config RCS		Quad helium main isolation valves and helium isolation valves at secondary fuel tanks verified open in 14.1.1 (step 5).
CP		SM RCS QUAD PRPLNT (4) - OPEN	2	OPEN position is momentary.
		SM RCS QUAD PRIM PRPLNT tb (4) - gray		Gray indicates quad fuel and oxidizer isolation valves open.
		SM RCS QUAD SEC PRPLNT tb (4) - gray		Gray indicates quad fuel and oxidizer isolation valves open.
		SM RCS PSM He - CLOSE		CLOSE position is momentary.
		PSM He tb - bp		Barber pole indicates helium isolation valves in PSM closed.
		PSM MANF ISOL vlv - CLOSE		
		PSM MANF ISOL tb - bp (verify)		Barber pole indicates both fuel and both oxidizer isolation valves in PSM closed.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		RCS IND sel - A (B,C,D)	2	
		SM RCS IND sw - PRPLNT QTY		
		SM RCS PSM PRPLNT (4) - CLOSE		CLOSE position is momentary.
		SM RCS PSM PRPLNT tb (4) - bp		Barber pole indicates at least one PSM manifold to quad propellant (fuel or oxidizer) isolation valve closed for separation. Any position of PSM helium and manifold isolation switches acceptable.
	10	CM RCS activation (req)		
		cb SECS ARM (2) - close		
		After STDN AOS		
AC		SECS LOGIC (both) - on (up)	8	Lever lock.
		Report logic arm		
		After GO from STDN		
		SECS PYRO ARM (2) - on (up)		Lever lock.
CP		CM RCS PRPLNT (both) - on (up) (verify)	2	On position is momentary.
		CM RCS PRPLNT tb (both) - gray		Indicates fuel and oxidizer isolation valves open.
		CM RCS PRESS - on (up)		Guarded. On position is momentary.
		RCS IND sel - CM 1, then 2		
		CM RCS He PRESS ind - 3600-3800 psia (after 15 min)		Immediately after pressurization, He pressure may drop below 3600 psia.
		CM RCS MANF PRESS ind - 287-302 psia		
AC	11	SECS PYRO ARM (2) - SAFE	8	Lever lock.
		If SCS - select POO	2	
	12	Strut unlock lanyard (2) - unstow & attach handle ends to MDC (req)	Side hatch	
	13	Go to THRUSTING, sec 12		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		14.2 CM/SM SEPARATION		
LP	1	If SM RCS deorbit Configure & preload bats		Prepares for battery preloading prior to CM/SM separation and verifies batteries transferred to main buses. (Previously configured in SPS or Hybrid Deorbit Thrusting of 12.2.1, 12.2.3, 12.3.1 or 12.3.3.)
		CAUTION If either bat bus A(B) current fails to incr after cycling respective MN BUS TIE switch, configure bats to main buses using cb BAT BUS A(B) BAT C	275	Assumes reconfiguration BAT A(B) and BAT C to MNA(B). cb MNA(B) BAT C closed in Deorbit Entry Vehicle Preparation, 14.1.
-12:00		MN BUS TIE BAT A/C - on (up) Verify bat bus A current incr &/or bat volt decr MN BUS TIE BAT B/C - on (up) Verify bat bus B current incr &/or bat volt decr	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line if cb MNA & B BAT C (2) - open, or three batteries on line for entry if circuit breakers closed (panel 275).
	2	Configure RCS		Assumes desired Attitude Control mode, 7.1, previously selected.
AC		AUTO RCS B/D ROLL B1 & B2 - MNA AUTO RCS B/D ROLL D1 & D2 - MNB AUTO RCS PITCH A3 & C4 - MNB AUTO RCS PITCH C3 & A4 - MNA AUTO RCS YAW B3 & D4 - MNA AUTO RCS YAW D3 & B4 - MNB	8	
CP		SM RCS QUAD PRPLNT (4) - OPEN (verify)	2	OPEN position is momentary. Opens 16 quad isolation valves.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SM RCS QUAD PRPLNT tb (8) - gray (verify)	2	Gray indicates quad fuel and oxidizer isolation valves open.
		SM RCS QUAD SEC FUEL PRESS (4) - OPEN (verify)		OPEN position is momentary. No talkbacks. Opens helium isolation valves between quad helium regulators and secondary fuel tanks.
		RCS IND sel - any quad SM RCS IND sw - TK PRESS/QTY (verify)		If in PRPLNT QTY position, indicator reads PSM or QUAD propellant quantity depending on position of RCS IND sel switch.
		SM RCS PSM PRPLNT (4) - CLOSE (verify) SM RCS PSM PRPLNT tb (4) - bp (verify)		Barber pole indicates at least one PSM manifold to quad propellant (fuel or oxidizer) isolation valve closed for separation. Any position of PSM helium and manifold isolation switches acceptable.
	3	Mnvr to sep att		Nominally deorbit burn attitude plus a 45° yaw out of plane.
AC		If CMC cont SC CONT - SCS	1	During separation, SCM RCS DAP acting upon CM would produce undesirable rates.
		or CMC MODE - FREE		
CP	4	RCS TRNFR - CM Test jets (if min imp, >1 cycle) RCS TRNFR - SM	2	Minimum impulse may not produce audible jet firing. More than 1 cycle may be required to clear propellant lines of residual pressure and allow propellant to jets
AC	5	DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI	1	Conserves propellant between separation and .05 g.

CM/SM SEPARATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	6	Configure telecom VHF AM (2) - off (ctr	3	
		OMNI ANT - C S BD ANT OMNI A - C S BD ANT OMNI - OMNI		
		If RCS deorbit TAPE RCDR FWD - FWD		
	7	Configure ECS		
AC		PRIM GLY TO RAD - BYP (pull)	325	
		REPRESS PKG vlv - FILL	326	Assures CM O2 supply full before CM/SM separation
		SRG TK O2 vlv - CN (verify)		
CP		O2 PRESS IND sw - SURGE TK	2	
		CRYO O2 PRESS 1 ind - 865-935 psia		
AC		REPPESS PKG vlv - CN	326	
		SM O2 SUP vlv - OFF		
DP		cb PRIM RAD CONT/MNA & B (2) - open	5	
		cb H2O/URINE DUMP HTR (2) - open		
CP		POT H2O HTR - OFF	2	
		GLY EVAP TEMP IN - MAN		Removes power from glycol mixer to conserve battery power.
AC		cb ELS/CM-SM SEP (2) - close	8	
	8	Arm SECS		
		SECS LOGIC (both) - on (up) (verify)		SECS LOGIC and pyro arm lever lock switches required for sequencing of CM/SM separation and landing events.
		SECS PYRO ARM (2) - on (up)		
CP	9	PRPLNT DUMP - RCS CMD (verify)	2	Was set to RCS CMD 61 seconds after lift-off. CM RCS activated in 14.1.4.
AC		EMS MODE - STBY (verify)	1	Should remain at STBY until just prior to entry interface to preclude false .05 G sensing.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	10	Sep from SM		
00:00		CM/SM SEP (both) - on (up)	2	Guarded. On position is momentary. Low limit SM system lights on at separation.
		SM C/W lts - on		
		C/W CSM - CM		
AC		MASTER ALARM pb/lt - on, push	1	
CP		SM C/W lts - out	2	
		Perform DM Jett, 4.4		
		RCS TRNFR - CM		CM position is momentary. Backup to automatic RCS transfer.
AC		CM RCS LOGIC - OFF	1	
	11	Sel Att Cont mode, 7.1		Entry DAP not turned on.
		Mnvr to entry att (or to SM RCS deorbit att if hybrid deorbit)		
		R_____°, P_____°, Y_____°		
	12	Set up for CM/RCS sys 1 (omit for hybrid deorbit)		G&N entry DAP will function with either one or both CM/RCS systems enabled.
		AUTO RCS A/C ROLL (4) - OFF	8	Electrically isolates CM RCS system 2 for entry. If a problem develops in system 1, disable affected channel and use direct RCS control.
		AUTO RCS CM 1 (6) - MNA or MNB		
		AUTO RCS CM 2 (6) - OFF		
	13	Go to P61 Entry Prep, 14.3.1		
	or	Go to SCS Entry, 14.4		
	or	If G&N Hybrid Deorbit, go to 12.2.3 (step 16)		
	or	If SCS Hybrid Deorbit, go to 12.3.3 (step 14)		

CM/SM SEPARATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		14.3 G&N ENTRY		
		14.3.1 P61 Entry Preparation	P61	displays predicted entry interface parameters and obtains EMS initialization parameters for comparison with STDN values.
		Required CMC - on, 8.1.3 ISS - on & orient known, 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT IMU (verify) .05 G sw - OFF (verify)		
CP	1	DSKY - P61 (sel at end of deorbit burn)	2	
		or Key V37E 61E		
		Poss PROG alarm (8.1.16)		R02.
		(R41 - State Vector Integration)		
		COMP ACTY lt - on (R41) COMP ACTY lt - flashes every 2 sec (ave G on)		Indicates state vector integration in process. Indicates integration complete, and average G on.
		Poss PROG alarm V05 N09 (10 sec) 01427 (IMU reversed)		Zero roll on FDAI is lift-down. -Ysm within 30° of $\underline{V} \times \underline{R}$. Alarm 01427 always displayed following P40 or P41 deorbit if platform aligned to preferred orientation computed in P40 or P41.
		or 01426 (IMU unsatisfactory for entry)		Neither +Ysm or -Ysm within 30° of $\underline{V} \times \underline{R}$.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	2	FL V06 N61		2	
		Impact Lat (+N)	XXX.XX DEG		Latitude and longitude of desired impact point.
		Impact Long (+E)	XXX.XX DEG		
		Hds Up/Dn (+up)	+/-00001		Heads up/down defines entry roll attitude.
		Accept PRO			
		Reject V25E, load desired values			Normally, these values loaded prior to deorbit.
	3	FL V06 N60 (entry data)			
		G max	XXX.XX G		Predicted maximum G level for an entry at nominal bank angle (L/D = 0.18).
		V pred	XXXXX. FPS		Predicted inertial velocity at entry interface (65.8 NM, 400,000 ft) above Fischer ellipsoid.
		Gamma EI	XXX.XX DEG		Flight path angle (between inertial velocity vector and local horizontal) at 65.8 NM (400,000 feet) above Fischer ellipsoid. Minus indicates flight path below horizontal plane.
		Rcd values			
		PRO			
	4	FL V16 N63			Display relative to erasable preloaded altitude value above Fischer ellipsoid.
		RTOGO (.05 G to splash)	XXXX.X NM		Range to go from preloaded erasable altitude value to splash.
		VIO (at .05 G)	XXXXX. FPS		Predicted inertial velocity at preloaded altitude value.

P61 ENTRY PREPARATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		TFE (time from .05 G) XXBXX MIN-SEC	2	Predicted time from now to preloaded altitude value (updated every 2 seconds). Predicts about 3 minutes longer than actual, following hybrid deorbit when called half hour before .05 G. Error varies, depending on how early P61 called after deorbit. 59B59 maximum reading (-above, +below).
		Rcd & compare with STDN		
AC		EMS - STBY/RNG SET (CW)	1	
		EMS MODE - STBY EMS FUNC - RNG SET (CW)		Do not go through EMS TEST positions.
		Set RNG ind - RTO30 from .05 G (STDN value) If req EMS FUNC - Vo SET (CCW)		Range to go from preloaded value to splashdown.
		Align scroll Vo to exact entry velocity (if req)		Predicted entry velocity may have been preset in EMS Entry Test, 14.1.3. Scroll can be slewed only one inch in reverse. In Vo SET position, both initial velocity in range integrator and scroll velocity change simultaneously.
		EMS FUNC - ENTRY Position EMS lt filter down (lts not covered)		Removing filter improves visibility of EMS lights during entry.
CP		Accept PRO (Exit P61) P61 calls P62 Go to G&N Entry, 14.3.2	2	
		Reject V32E, recycle to step 3		Obtains new state vector and updated N60.

STA/T STEP		PROCEDURE	PANEL	REMARKS
		14.3.2 P62, P63, P64, P67 Entry		
		Required CMC - on, 8.1.3 ISS - on & orient known, 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify)		
CP	1	DSKY - P62 Auto sel by P61 (bypasses state vctr extrapolation reqt)	2	
	or	If FL V37 Key 62E		
	or	Key V37E 62E (ave G reinitiated)		
		Poss PROG alarm (8.1.16)		R02.
		(R41 - State Vector Integration)		R41 bypassed if P62 called by P61.
		COMP ACTY lt - on (R41)		Indicates integration in process.
		COMP ACTY lt - flash every 2 sec (ave G on)		Indicates integration complete, and average G on.
		Poss PROG alarm V05 N09 (10 sec) 01427 (IMU reversed)		Zero roll on FDAI is lift-down. -Ysm within 30° of V x R. Alarm 01427 always displayed following P40 or P41 deorbit if platform aligned to preferred orientation computed in P40 or P41.

P62, P63, P65, P67 ENTRY

STA/T STEP	PROCEDURE	PANEL	REMARKS
CF	or 01426 (IMU unsatisfactory for entry)	2	Neither +Ysm or -Ysm within 30° of V x R.
2	FL V50 N25 00041 (request CM/SM sep)		If CM and SM not separated prior to this step, separation should be accomplished now per 15.2. V37s except P00, inhibited after response to this display. Any program not requiring DAP control may be selected from P00. P62 should be reselected before entry into atmosphere since average G terminates by going to P00.
3	PRO		Starts entry DAP. Roll attitude error scaling changed in G&N for compatibility with 50/15/50/10 FDAI scale position. After PRO and until 50/15/50/10 selected, full scale roll error 20°, not 5°.
4	FL V06 N61 Impact lat (+N) XXX.XX DEG Impact long (+E) XXX.XX DEG Hds Up/Dn (+up) +/-00001		Latitude and longitude of desired impact point. Defines entry roll attitude.
	Accept PRO If α <45° - DSKY P63, go to 6 Reject V25E load new data		If α within 45° of (-) velocity vector, P63 automatically called.
5	V06 N22 (mon) R, P, Y XXX.XX DEG If α >45° 21 sec after α <45°, DSKY P63		Final gimbal angles at EI. Display bypassed and P63 called if α within 45°.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	ORDEAL Pitch - ___° (Hds up) ORDEAL Pitch - ___° (Hds down)	2	IMU inertial attitude on FDAI 1 and ORDEAL local vertical attitude on FDAI 2.
	7	DSKY - P63		
AC	8	After CM/SM sep & CM stab at entry att EMS MODE - NORM	1	Left in STBY until after separation and stabilization; if no postburn update, and for RCS deorbit, start EMS by positioning EMS MODE from STBY to BU at STDN supplied value of RET .05 G. Also refer to 6.1.1, note 10.
		DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI FDAI SCALE - as desired		
AC,CP		Mon FDAIs & RSI	1,2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		If abnormal veh dynamics Damp rates with dir RCS RHC PWR DIR (both) - OFF	1	This procedure sequence minimizes failure isolation time. (Another functionally acceptable method disables AUTO RCS switches first, then RHC direct power.)
		If abnormal veh dynamics continue RHC PWR DIR (both) - MNA/MNB Damp rates with dir RCS AUTO RCS (affected axis) - OFF Continue with dir RCS (affected axis)	8	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	9	V06 N64 (mon)		2	N68 and N74 available if desired.
		Drag accel	XXX.XX G		
		VI	XXXXX. FPS		Inertial velocity (nominal).
		Range to splash (+ overshoot)	XXXX.X NM		Range to go to desired splashpoint located at calculated impact time (decreasing). Display bypassed on first 2-second cycle.
DP		PCM BIT RATE - HI		3	
		TAPE RCDR RCD - RCD			
		TAPE RCDR FWD - FWD			
AC		BMAG MODE (3) - RATE 2		1	Cages attitude BMAGs. Prevents SCS-driven FDAI roll stability indicator from jumping when GA 1 BMAGs automatically cage at .05 G.
		MAN ATT (3) - RATE CMD			Configuration required for auto G&N entry and normally selected at last status check prior to .05 G.
		SC CONT - CMC			
		CMC MODE - AUTO, HOLD, or FREE			Entry DAP does not look at CMC MODE switch.
CP		DSKY - P64 (at .05 G)		2	CMC changes Entry DAP from attitude hold in alpha and beta to rate damping in pitch and yaw (roll unchanged).
		EMS MODE - BU			EMS started manually to ensure start of range indicator at fixed position (range from target) as defined by RTCC.
		.05 G lt - on			.05 G lt will not necessarily occur simultaneously with P64 on DSKY.

NORMAL BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
AC		.05 G sw - on (up) EMS ROLL - on (up) Scroll slews to left RNG ind decr		1	.05 G and EMS ROLL switches should be placed on simultaneously to minimize EMS error.
CP	10	V06 N74 (mon)		2	N64 and N68 available if desired.
		Beta	XXX.XX DEG		Commanded bank angle.
		VI	XXXXX. FPS		Inertial velocity (decreasing).
		Drag accel	XXX.XX G		Drag acceleration (increasing).
AC		Compare RSI & ball for lift vctr G-V plot within limits		1	Violation of an EMS G onset ray should be followed by an orientation to lift vector up. Violation of an EMS G offset ray should be followed by an orientation to lift vector down. If at point of tangency, G&N not commanding lift-up or lift-down, manually orient CM and terminate G&N steering.
0.2G					
CP	11	DSKY - P67		2	P67 continues entry guidance from ≈0.2 G until termination of steering when the CM velocity with respect to earth = 1000 ft/sec (≈10.7 NM altitude). N64, N68, and N74 available if desired.
AC		EMS - 0.2 G (if 10 sec since .05 G)		1	
CP	12	V06 N66 (mon)		2	
		Beta	XXX.XX DEG		Commanded bank angle (-command will correct for + cross range error).
		CRSRNG ERR	XXXX.X NM		CMC solution for cross range error (+ target south of direction of motion).
		DWNRNG ERR	XXXX.X NM		CMC solution for down range error (decreasing); + is overshoot. Will be 9999.9 after overshoot of target.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Key VERB (freeze disp) Compare DWNRNG ERR to pad data (DWNRNG ERR within 100 NM of pad data)	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If DWNRNG ERR not within 100 NM		
AC		Maintain BBA entry		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		KEY REL (reinstates V06 N66 mon)		
AC		Fly roll cmd Mon lift vctr on RSI & ball	1	
CP	13	FL V16 N67 (mon) Range to splash XXXX.X NM (+ ovsht) Lat present position XXX.XX DEG (+ N) Long present position XXX.XX DEG (+ E) (V REL = 1000 fps at ≈65K')	2	Range to go to desired splashpoint (+ is overshoot). Latitude of present position (+ is north). Longitude of present position (+ is east).
		If R1 = -, lift-up; +, lift-down		
AC		Mon altimeter Rcd lat, long, & voice to RECY at 10K' Rcd EMS RTOGO EMS - STBY/OFF EMS MODE - STBY EMS FUNC - OFF	1	
	14	Go to Earth Ldg Phase (<50K'), sec 15		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		14.4 SCS ENTRY		Assumes CM and SM separated. During entry, do not "fly to" a pegged rate needle. For this contingency, control to operational attitude ball or out-the-window visual cues.
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify) RSI aligned, 14.1.2		
AC	1	Verify/mnvr to entry att EMS Entry Test (req), 14.1.3		SCS acceleration command recommended until .05 G for failure takeover considerations.
	2	EMS - STBY/RNG SET (CW) EMS MODE - STBY EMS FUNC - RNG SET (CW) Set RNG ind - RTGO from .05 G (STDN value)	1	Do not go through EMS TEST positions. The following steps to be done as soon as possible after deorbit ΔV.
	3	EMS FUNC - Vo SET Realign scroll Vo to exact entry velocity (if req)		Predicted entry velocity may have been preset in EMS Entry Test, 14.1.3. Scroll can be slewed only one inch in reverse. In Vo SET position, both initial velocity in range integrator and scroll velocity change simultaneously.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	4	EMS FUNC - ENTRY	1	
	5	Align RSI to desired angle (if necessary) ATT SET - GDC EMS ROLL - on (up) GDC ALIGN pb - push, hold ATT SET YAW tw - adj ±45°, position RSI GDC ALIGN pb - rel EMS ROLL - OFF ATT SET YAW tw - reset GDC ALIGN pb - push (32 sec max)		This alignment may be performed prior to launch or prior to deorbit. EMS roll stability indicator alignment provides indication of backup bank angle (BBA).
	6	After CM SM sep & CM stab at entry att EMS MODE - NORM DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI FDAI SCALE - 50/15/50/10 BMAG MODE (3) - RATE 2 MAN ATT ROLL - ACCEL CMD MAN ATT PITCH & YAW - RATE CMD		Left in STBY until after separation and stabilization; if no postburn update, and for RCS deorbit, start EMS by positioning MODE switch from STBY to FU at STDM supplied value of RET .05 G. Also refer to 6.1.1, note 10. Cages attitude BMAGs, preventing SCS-driven FDAI RSI jumping at .05 G when GA 1 attitude BMAGs automatically caged to furnish rate information for SCS-driven FDAI RSI. This configuration can be delayed, as close to .05 G as convenient, for propellant conservation.
DP		PCM BIT RATE - HI TAPE RCDR RCD - RCD TAPE RCDR FWD - FWD	3	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC,CP		Monitor FDAIs & RSI	1,2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		If abnormal veh dynamics Damp rates with dir RCS RHC PWR DIR (both) - OFF	1	This procedure sequence minimizes failure isolation time. (Another functionally acceptable method disables AUTO RCS switches first, then RHC direct power.)
		If abnormal veh dynamics continue RHC PWR DIR (both) - MNA/MNB Damp rates with dir RCS AUTO RCS (affected axis) - OFF Continue with dir RCS (affected axis)	8	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	7	EVNT TMR ind - mon for .05 G time .05 G lt - on	1	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no .05 G lt by RET .05 G +3 sec		Backup cue may be obtained from STDN or CMC.
		EMS MODE - BU		Lift vector lights do not function in EMS BU mode. If RNG indicator not decreasing, EMS ranging capability lost.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		.05 G sw - on (up)		At .05 G +10 sec, one lift vector light will come on; disregard light.
		EMS ROLL - on (up)		.05 G and EMS ROLL switches should be placed to on simultaneously to minimize roll attitude error.

SCS ENTRY

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Scroll slews to left, RNG ind decreases	1	If scroll slews in one axis (V or G), that axis is usable.
	Mnvr to BBA & maintain until range potential guidelines can be interpreted, then null range err using range potential guidelines & EMS RNG ind. While nulling range err, avoid tangency to G on-set lines. Reverse bank angle at RETRB to null lateral range err.		BBA is backup bank angle. Disregard corridor lamps (as corridor verification cues) for entry from earth orbit (entry velocity <35K fps). RETRB is retrofire elapsed time to reverse bank.
8	Go to Earth Landing Phase (<50K'), sec 15		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		15.0 EARTH LANDING PHASE (<50K')		
AC				
50K'		CAB PRESS RELF vlv (2) - BOOST/ENTR (safety latch on)	325	
		Report CM stable		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		CM unstable		
CP				
40K'		RCS CMD - OFF	2	OFF position is momentary.
AC		APEX COVER JETT pb - push	1	Guarded.
		DROG DPLY pb - push (2 sec after apex cover jett)		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
30K'		ELS LOGIC - on (up)		Guarded.
		ELS AUTO - AUTO		
CP		SEC COOL EVAP - off (ctr)	2	Required only if secondary loop in operation.
		GLY EVAP H2O FLOW - off (ctr)		
24K'		SCS RCS disable (auto)		
		xxxxxxxxxxxxxxxxx		
		RCS CMD - OFF		OFF position is momentary.
		xxxxxxxxxxxxxxxxx		
		Apex cover jett (auto)		Apex cover will be jettisoned at 24K feet plus 0.4 second.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		APEX COVER JETT pb - push	1	Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Drogue chutes deployed (auto)		Drogue parachutes deployed at 24K feet plus 2.0 seconds. The CM may be very unstable until drogue chutes disreef in ≈11 seconds.
		xxxxxxxxxxxxxxxxxxxxxxx		
		DROG DPLY pb - push		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxx		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no drogue deployment ELS AUTO - MAN Stabilize CM with dir RCS		
		5K' MN DPLY pb - push ELS AUTO - AUTO		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP				
23.5K'		Monitor CAB PRESS ind - starts increase	2	No increase indicates cabin pressure relief valve failure.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		If no increase by 17K' rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	RH valve has four positions.
CP		If still no increase CAB PRESS DUMP vlv - open (CCW)	Side hatch	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP 10K'		CAB PRESS ind - 10 psia	2	Indication of main chute deploy altitude.
		Main chutes & VHF recovery ant deploy (auto)		Auto deployment occurs between 10,950 and 9,100 feet. Parachutes disreef ≈15 seconds after pilot mortars fire.
AC		MN DPLY pb - push	1	Guarded.
DF		Set up entry communications VHF ANT - RECY VHF AM A - SIMPLEX VHF BCN - ON	3	If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.
AC		Transmit voice (VHF AM) reporting Position Main chutes disreefed Splash error Crew status		Continue voice transmission until touchdown.
CP		Crew couch struts (4) - unlock		
AC		CAB PRESS RELF vlv (2) - DUMP (safety latch off)	325	
		If night landing cb FLOAT BAG (all) - close PL BCN LT - LO	8 15	The postlanding beacon light has longer operating life in LO.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		cb FLT/PL BUS BAT A, B & C (3) - close cb FLT/PL BUS MNA & B (2) - open	5	Connects battery bus A, B, and battery C to flight and postlanding bus.
AC		cb SPS PITCH (both) - open cb SPS YAW (both) - open	8	
CP		CM RCS PRPLNT (both) - OFF	2	OFF position is momentary.
		CM RCS PRPLNT tb (both) - bp		Barber pole indicates at least one valve (fuel or oxidizer) closed in the particular system 1 or 2.
AC BP		FLOOD FIXED - POST LDG	8	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area. Minimize floodlight use during postlanding. Maximum utilization should be 9.6 hours per 48-hour period.
		FLOOD DIM - 1 or 2		Position 1 provides power to two secondary floodlights and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position after dc main buses are deactivated.
CDR		CAB PRESS RELF vlv (2) - CLOSE (safety latch off)	325	Valves must be closed prior to touchdown to prevent water from entering CM.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW)	Side hatch	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		ELS AUTO - AUTO (verify)	1	
		ELS LOGIC - on (up) (verify)		Guarded.
		DIRECT O2 vlv - OPEN (CCW) (if suited)	7	
DP		MN BUS TIE (2) - OFF	5	Removes battery power from dc main buses.
		CAUTION MN BUS TIE switches must be left OFF to ensure that entry batteries A, B, & C are used to power PL bus only, & to prevent battery shorting caused by water entering CM feed-thru connectors.		
		cb BAT RLY BUS (2) - open		
		Postlanding Check, sec 16		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		16.0 POSTLANDING		
		16.1 POSTLANDING STABILIZATION		
DP		cb MN REL (2) - close	229	
CP		MN REL - on (up)	2	Guarded. On position is momentary. Releases main parachutes.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no main chute release		
AC		ELS AUTO - AUTO (verify)	1	Switch should have been on at least 14 seconds to allow timer to time out and enable MN REL switch.
		ELS LOGIC - on (up) (verify)		Guarded.
CP		MN REL - on (up)	2	Guarded. On position is momentary.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		WARNING		
		If fire or smoke after impact, refer to Fire/Smoke in CM During Postlanding, 20.3.1		
AC		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		If not in contact with recovery forces		
ALL		VHF AM (3) - RCV	9,10,6	
DP		VHF AM A - off (ctr)	3	
		VHF AM RCV - A		

S/C/T	STEP	PROCEDURE	PANEL	REMARKS
AC		cb PL VENT FLT/PL - close	8	
		cb FLOAT BAG (all) - close		
DP		cb UPR SYS COMPR (both) - close	278	
		If floating upright		
		CAUTION Wait 10 minutes prior to initiating bag fill. This allows ablator to cool sufficiently prior to inflation. Heat can destroy bags.		
AC		FLOAT BAG (all) - FILL for 7 min, then OFF	8	Lever lock. Wait 15 minutes prior to running compressors again.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If floating inverted		
		FLOAT BAG (all) - FILL		Lever lock.
DP		VHF BCN - OFF	3	
		VHF AM A - off (ctr)		
		Two min after upright		
AC		FLOAT BAG (all) - OFF	8	Lever lock.
DP		VHF BCN - ON	3	
		If in contact with recovery forces prior to floating inverted		
		VHF AM A - SIMPLEX		If VHF AM B SIMPLEX or VHF AM A DUPLEX required, turn off beacon during period of communication.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If CM fails to upright in 7 min & CM rolls CW		Crew reposition procedures may be required if uprighting does not occur in 7 minutes and sea state is minimal.
AC	FLOAT BAG 2 R - OFF (Continue uprighting for 8 additional min)	8	Lever lock.
CP,AC	If uprighting does not occur in 3 min, reposition to area behind AC's couch and CP's couch as near as poss to B3 stowage locker		
	or CM rolls CCW		
AC	FLOAT BAG 1 L - OFF (Continue uprighting for 8 additional min)		Lever lock.
DP,CP	If uprighting does not occur in 3 min, reposition to area behind DP's couch & CP's couch		
	or No roll		
AC	FLOAT BAG 3 CTR - OFF (Continue uprighting for 8 additional min)		Lever lock.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP,DP	If uprighting does not occur in 3 min, reposition to area on top of or along lower equip bay canisters WARNING If CM still does not upright, egress should be completed before total time in unventilated CM exceeds 2-1/2 hours. Refer to Stable II Water Egress Procedure, 16.4.3.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		16.2 POST STABILIZATION AND VENTILATION		
ALL		Release footstraps Release restraint harness		
DP		cb MNA BAT BUS A & BAT C (2) - open	275	
		cb MNB BAT BUS B & BAT C (2) - open		
		cb FLT/PL BUS BAT C - open	5	Battery C and pyro batteries held in reserve for use after depletion of battery A and B charge.
		cb PYRO BUS A/PYRO BAT A - open	229	
		cb PYRO BUS B/PYRO BAT B - open		
		DC IND sel - BAT BUS A,B	3	
		DC VOLTS ind - >27.5 vdc		
		When BAT BUS A(B) = 27.5 vdc, monitor that bus continuously		
		If BAT BUS A & B (2) <27.5 vdc		
		cb FLT/PL BUS BAT C - close	5	
		cb FLT/PL BUS BAT A & B (2) - open		
		Go to Comm Low Pwr Procedures, 16.3.3, and monitor BAT C voltage		
CP		PLV distribution duct (3) - unstow and install		Stowed in aft bulkhead stowage area.
		Remove debris trap from left X-X head strut at MDC		Allows cabin air to flow to PL valve exhaust port on forward bulkhead.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION PL VENT vlv handle must be fully extended (pulled until detent button re-extends) to disengage valve locking pins.		
CP		PL VENT VLV - PULL (unlock)	2	Press detent button to release handle. Handle secured in locked or unlocked position when detent button extended.
AC		PL VENT - HI or LO	15	PLV fan can operate in high flow for 12 hours maximum. During periods of no PLV fan operation, cycle PLV 5 minutes every half hour. If RCS fumes are noticed, prepare to egress immediately. PL VENT should be cycled from HI to LO prior to using manual backup procedure.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no PLV operation or ventilation inadequate		Audible fan operation does not indicate both inlet and outlet valves are open.
		To disengage locking pins		
		PL VENT - OFF		
		PL VENT VLV - push then PULL	2	
		PL VENT - HI or LO	15	
		If still no PLV operation		
		To initially open valves		
		PLVC sw - OPEN	376	If PLV valves cannot be opened, side hatch or dump valve can be opened as required to obtain fresh air.
		To close valves		Total time in unventilated CM should not exceed 2-1/2 hours.
		PL VENT - OFF	15	
		To reopen valves		
		PL VENT - HI or LO		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		PL BCN LT - LO	15	After dark only. Place PL BCN LT - HI only at request of recovery forces.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no flashing light		Perform backup duty cycle at request of recovery forces.
		FLOOD FIXED - POST LDG for 1/2 min OFF for 1/2 min	8	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Deploy dye marker & swimmer umbilical DYE MARKER - on (up)	15	Guarded. On (up) position is momentary.
ALL		INTERCOM (3) - T/R (verify)	9,10,6	Required for swimmer umbilical operation.
AC		Deploy line grappling hook (if req) CAB PRESS DUMP vlv - remove Grappling hook & line - deploy through valve opening Cover plate - secure	Side hatch	Grappling hook deployed on request for snagging sea anchors deployed by recovery forces. Adapter E and driver R tools required to remove cabin pressure dump valve and secure cover plate on side hatch (over valve opening).
		Go to Nominal Egress, 16.5		

16.2 POST STABILIZATION AND VENTILATION

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	16.3 POSTLANDING COMMUNICATIONS		
	16.3.1 Normal Postlanding Communications		
DP	VHF BCN - ON (verify) VHF ANT - RECY (verify)	3	
	If no contact with recovery forces VHF AM B - SIMPLEX Monitor for VHF beacon 1000 Hz tone (2 sec on, 3 sec off) VHF AM B - off (ctr) If VHF beacon not audible Remove survival transceiver from stowage and mount antenna Select VOICE on transceiver Monitor VHF beacon for 1000 Hz tone (2 sec on, 3 sec off) If VHF beacon operating Turn off survival transceiver Stow transceiver in RHFEB		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If no VHF beacon signal, turn off transceiver, remove antenna, & connect transceiver to S/C antenna per **16.3.2** Select BCN on transceiver Monitor VHF AM for comm initiated by recovery aircraft		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	16.3.2 Survival Transceiver Communications		
	VHF BCN - OFF (if no contact after 24 hrs)	3	Conserve spacecraft power for terminal phase of recovery operations.

SURVIVAL TRANSCEIVER COMMUNICATIONS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Survival transceiver/VHF BCN antenna cable connection		
		Remove survival transceiver from stowage		
		Unlatch & open VHF antenna access door		A 5/32" hex wrench (tool E), required for opening two hex fasteners on antenna cable access door.
		Disconnect P112 connector from beacon		An adjustable wrench (tool F), is used to loosen 5/8" hex on coax connector.
		Attach transceiver cable P1 connector to transceiver (verify)		
		Connect transceiver cable J1 connector to P112 connector		
		Select BCN on transceiver		
	16.3.3	Communications Low Power Procedures		
		VHF BCN - OFF		
AC		FLOOD FIXED - OFF	8	Turns off postlanding floodlights.
DP		VHF AM A - off (ctr)	3	
		VHF AM RCV - A		
AC		PL VENT sys - minimize use		
		Survival transceiver - connect to VHF BCN antenna cable (refer to Survival Transceiver Communications, 16.3.2)		
		If BAT C <27.5 vdc		
DP		cb BAT BUS A BAT A - open	275	
		cb BAT BUS A PYRO BAT A - close		
		cb FLT/PL BUS BAT A - close	5	
		cb FLT/PL BUS BAT C - open		
		Monitor PYRO BAT A voltage on BAT BUS A		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If PYRO BAT A <27.5 vdc		
DP		cb BAT BUS B BAT B - open	275	
		cb BAT BUS B PYRO BAT B - close		
		cb FLT/PL BUS BAT B - close	5	
		cb FLT/PL BUS BAT A - open		
		Monitor PYRO BAT B voltage on BAT BUS B		
	16.3.4	S/C Power Down (Extended Comm Period)		Spacecraft power conserved for extended survival communications period.
AC		PL VENT - OFF	15	Postlanding vent system use should be minimized; however, total time without ventilation or CM 02 supply should not exceed 2-1/2 hours. Side hatch or dump valve can be opened as required to obtain fresh air if no PL VENT operation.
DP		cb FLT/PL BUS BAT C - open	5	
		cb BAT CHRG BAT C/EDS 2 - open		
		cb panel 275 - all open	275	
		Power up as req, 16.3.3		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		16.4 UNAIDED EGRESS PROCEDURES		
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
		If no ventilation or CM 02 supply STABLE I - open side hatch as req STABLE II - initiate egress within 2-1/2 hours		
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
		16.4.1 Egress Preparation		
ALL		Disconnect umbilicals (if suited)		
		Neck dams on (if suited)		
		Configure couch seat pans Center couch - 270° position L & R couch - 270° position (if stable II egress anticipated)		
AC,DP		Armrests folded (stowed)		
ALL		If unsuited, transfer scissors from suit to coveralls		Scissors may be required to cut mooring lanyard in an emergency.
		Tape flight penlight to wrist (night egress)		
DP		Survival kits removed from stowage	R-4	
		Remove lanyards from rucksack kit No. 2 & reclose rucksack		
CP		Connect liferaft mooring line (olive drab) to CM		
		Connect lanyard titled "attach to first crewman out" to suit (if unsuited attach to buckle on life vest)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Connect lanyard titled "attach to second crewman out" to suit (if unsuited attach to buckle on life vest)		
AC		Connect lanyard titled "attach to third crewman out" to suit (if unsuited attach to buckle on life vest)		
		16.4.2 Stable I Water Egress		
AC		PL VENT - OFF	15	
DP		cb FLT/PL BUS BAT C - open	5	
		cb BAT CHRG BAT C/EDS 2 - open		
		cb panel 275 - all open	275	
CP		Charge hatch counterbalance	Side hatch	
		GN2 ratchet handle - operate		
		GN2 vlv handle - unlock & push outboard		
		Open side hatch		
		Lock pin rel knob - UNLATCH		
		Gear box sel - UNLATCH		
		Actr handle sel - U (unlatch)		
		Actr handle rel - push or squeeze		Push button or squeeze bar to release actuator handle for operation.
		Actr handle - operate (until hatch can be opened)		
		Push hatch open		
		Act handle sel - N (neut)		
		GN2 vlv handle - vent (pull inboard)		
		GN2 vlv handle - press (push outboard)		

STABLE I WATER EGRESS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Check pressure gage (mid-white)		Counterbalance vented to mid-white range to assist in securing spacecraft hatch after crew egress.
		Repeat vent, press cycle, as req to obtain mid-white range		
AC		Remove life raft from rucksack kit No. 2		
		Simultaneously throw life raft overboard and pull inflation lanyard		
		Place hardware rucksack in raft		
		Egress, inflate life vest, board raft		
DP		Egress, inflate life vest, board raft		
CP		Egress, inflate life vest, board raft		
	16.4.3	Stable II Water Egress		
ALL		PWR (3) - OFF	6,9,10	
		SUIT PWR (3) - OFF		
CP		PRESS EQUAL vlv - OPEN	Fwd hatch	Pull detent knob on end of handle, then pivot up 90°. Rotate crank ≈3 turns CCW to fully open valve. This will flood tunnel prior to opening hatch.
		WARNING To prevent injury to crew members, do not unlock hatch until flooding stops and pressure equalizes in CM.		
CP		Actr handle rel - pull and rotate	Fwd hatch	To free actuator handle for operation, release is rotated to mechanical stop.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Actr handle - pull to stop Actr handle sel - U (unlatch) (CCW 90°) Actr handle - push to stop Actr handle sel - stow (CW 90°) Actr handle - push to stowed position		Actuator handle should move ≈80°. Actuator handle should move 60° to release hatch.
CP,DP		Remove & stow fwd hatch		Forward hatch weighs ≈85 lbs and is stowed in LHEB.
CP		Lower hardware rucksack down tunl. When rucksack clear of tunl, lower life raft package down tunl holding package with yellow lanyard Exit feet first; when clear of CM, inflate life vest		
DP		Exit feet first; when clear of CM, inflate life vest		
CP,DP		Remove life raft from rucksack No. 2 and inflate raft		
AC		Disconnect life raft mooring line (olive drab) from CM and return end of line (AC's discretion) Exit feet first; when clear of CM inflate life vest Reconnect life raft mooring line (olive drab) to SC exterior - sea anchor hardpoint or EVA handles (AC's discretion)		
	16.4.4	Side Hatch Operations - Rough Sea		
CP		Close side hatch GN2 vlv handle - pull (inboard)	Side hatch	Vents counterbalance piston chamber. Squeeze handle to unlock.

SIDE HATCH OPERATIONS - ROUGH SEA

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		GN2 press ind - minimum		
		Open door rel handle - pull		D-ring.
		Verify latches are in open position		
		Close hatch		
		Actr handle sel - L (latch)		
		Gear box sel - LATCH		
		Open door rel handle - stow		
		Actr handle rel - push or squeeze		Push button or squeeze bar to release actuator handle for operation.
		Actr handle - operate (while holding hatch closed)		
		Lock pin rel knob - LOCK (auto)		Verify lock pin has automatically engaged.
		LOCK PIN ind - not extended		Indicates lock pin engaged.
		Actr handle - stowed		
		Re-open side hatch		
		Lock pin rel knob - UNLOCK		Pin can be sheared if left in LOCK position.
		Gear box sel - UNLATCH		
		Actr handle sel - U (unlatch)		
		Actr handle rel - push or squeeze		
		GN2 vlv handle - push (outboard)		
		GN2 press ind - green		
		Actr handle - operate (until hatch can be opened)		Actuator handle should not be operated until immediately prior to egress.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		16.5 NOMINAL EGRESS PROCEDURES		
		16.5.1 Nominal Egress Preparation		
ALL		Disconnect umbilicals (if suited)		
		Neck dams on (if suited)		
CP		Configure center couch - 270° position		
AC,DC		Armrests folded (stowed)		
		16.5.2 Nominal Egress & Power Down		
AC		PL VENT - OFF	15	
DP		Nominal egress panel Config		
		cb FLT/PL BUS BAT C - open	5	
		cb BAT CHRG BAT C/EDS 2 - open		
		cb pnl 275 - all open	275	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Post abort panel config		
		PL BCN LT - LO (verify)		VHF beacon and flashing light left operating to aid CM recovery after an abort.
ALL		VHF AM - OFF (ctr)	6,9,10	
DP		VHF AM A(B) - OFF (ctr)	3	
		VHF BCN - ON (verify)		
		cb BAT CHRG BAT C/EDS 2 - open	5	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		Charge hatch counterbalance	Side hatch	
		GN2 ratchet handle - operate		
		GN2 vlv handle - unlock & push outboard		
		Open side hatch (after collar installed)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Lock pin rel knob - UNLOCK	Side hatch	
		Gear box sel - UNLATCH		
		Actr handle sel - U (unlatch)		
		Actr handle rel - push or squeeze		Push button or squeeze bar to release actuator handle for operation.
		Actr handle - operate (until hatch can be opened)		
		Push hatch open		
		Actr handle sel - N (neut)		
		GN2 vlv handle - vent (pull inboard)		
		GN2 vlv handle - press (push outboard)		
		Check pressure gage (mid-white)		Counterbalance vented to mid-white range to assist in securing spacecraft hatch after crew egress.
		Repeat vent press cycle as req to obtain mid-white range		
AC		Egress, inflate life vest, board raft		
DP		Egress, inflate life vest, board raft		
CP		Egress, inflate life vest, board raft		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	17.0	CSM/DM EXPERIMENTS		Technical investigations (experiments) that support science in general or provide engineering, technological, medical, or other data; and technical (in flight) demonstrations of the capabilities of apparatus and/or processes to illustrate or utilize the unique conditions of space flight environment.
	17.1	Not Applicable		
	17.2	G&C SYSTEMS PREPARATION		Establishes basic requirements for guidance, control, and maneuver functions required for experiment operations.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1		
AC		Config SM RCS for single jet control	8	Maintain SM RCS single jet control during experiment operations.
	17.3	Not Applicable		
	17.4	Not Applicable		
	17.5	Not Applicable		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.6 ULTRAVIOLET ABSORPTION (UVA)		MA-059. Measures concentrations of atomic oxygen and atomic nitrogen in the atmosphere by optical absorption spectroscopy. Performed with tunnel 1 hatches open to provide drag through cable access from Command Module to docking module.
		17.6.1 Connect Drag Thru Cable		
DP		Verify cb UVA EXP MNB - open cb UVA COVER MNB - open UVA PWR - OFF UVA LAMPS - OFF UVA COVER - ctr UVA COVER tb - gray	230	
		Remove UVA PWR J1 dust cap on pnl 230		
		Obtain UVA drag thru cable from stowage. Remove & stow connector dust caps		
		Conn drag thru connector P1 to J1 on pnl 230 (TBD to TBD)		
		Route P2 end of drag thru cable through tunnel 1 to crewman in DM.		
(DM)		Remove UV ABSORPTION J2 dust cap on pnl 862	862	
		Conn drag thru connector P2 to J2 on pnl 862 (TBD to TBD)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.6.2 UVA Cover Open (Close)		
		DRAG THRU CABLE connected, 17.6.1		
DP		cb UV MNB - close (verify)	274	
AC		AUTO RCS B3, C4, & D4 (3) - OFF	8	
DP		cb UVA COVER MNB - close	230	
		UVA COVER - OPEN (CLOSE)		Cover must be closed during and remain closed for 15 minutes following spacecraft dumps. Cover must be closed when instrument FOV centerline within 20° of sun.
		UVA COVER tb - gray,-bp(<5 sec),-gray		Talkback is barberpole while cover is between full open or full closed, (less than 5 seconds).
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If bp >15 sec		Contact STDN for further instructions.
		cb UVA COVER MNB - open		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		cb UVA COVER MNB - open		
		17.6.3 UVA/COAS Alignment		Provides alignment check of UVA to COAS FOV and star UV reference data accumulation.
		G&C Syst Prep, 17.2 (req)		
		Opt - on, 8.1.4		
AC		COAS PWR - on (up)	15	COAS previously installed and calibrated for IMU alignment at Post Orbital Insertion.
		Open UVA COVER, 17.6.2		
DP		cb UVA EXP MNB - close	230	
		UVA PWR - ON		Instrument turned on 5 minutes prior to operation for data accumulation to allow star tracking system warmup.
CP		SYS TEST (2) - 1L	101	UVA EXP POINTING ERROR display.
		SYS TEST ind - 0-5 vdc (cycling)		With no return signal, meter cycles between 0 and 5 vdc once per second.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		UVA FOV to COAS FOV Calib		
		Close UV COVER, 17.6.2 if mnvr thru sun line to calib star		
		Using lst mag or brighter trgt star perform UVA FOV calibr, 13.1.8 steps 1 thru 6, then		
CP		PRO to N92	2,140	
		V06 N92		
		SA XXX.XX DEG		
		TA XX.XXX DEG		
		Open UVA COVER, 17.6.2 if closed for mnvr		
		Mnvr in yaw to zero tgt star in COAS		
		SYS TEST ind - mnvr in pitch to attain 2.5V UV pointing signal on meter. When SA & TA relatively constant & 2.5V UV pointing signal	101	If meter oscillating, pointing attitude is >3 degrees off center of UVA target FOV. If meter indicates <2.5V, pitch down. If meter indicates >2.5V, pitch up
		KEY VERB (to freeze disp)	2,140	
		Accept Rcd SA & TA for use in mnvr to UV trgt		Provides UV instrument alignment offset bias to enable more precise maneuver pointing accuracy.
		Reject KEY REL Repeat V06 N92		
		Sel desired prog		
		Opt - as req		
AC		COAS PWR - OFF	15	
		UVA Calibration, 17.6.6		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.6.4 UVA Operation		
		G&C Syst Prep, 17.2 (req)		
AC		COAS PWR - on (up)	15	
		Open UVA COVER, 17.6.2		
DP		cb UVA EXP MNB - close	230	
		UVA PWR - ON		
		UVA LAMPS - ON		Lamps must be on for 30 minutes prior to operation for data accumulation.
CP		SYS TEST (2) - 1L	101	UV EXP POINTING ERROR display.
		VHF AM Ranging Mode, 5.6.4		
		(V49) mnvr to acq Soyuz reflector		Maneuver using PAD or on-board chart data corrected for UV instrument alignment offset bias.
		Acq Soyuz reflector in COAS		
		Mnvr in yaw to zero reflector in COAS		
		SYS TEST ind - mnvr in pitch to 2.5V, UV pointing signal on meter		If meter indicates <2.5V, pitch down. If meter indicates >2.5 V, pitch up.
		Mnvr as req for data collection		
		To rotate about a target vector, sel P20, Opt 2, 10.2.1		Maneuver includes rotating about Soyuz at distances of 150, 500, and 1000 meters with CSM sweep at approximately 3°/min, across Soyuz retro-reflector, while maintaining experiment pointing accuracy.
		To translate for subs data collection		
		Close UVA COVER, 17.6.2		
AC		AUTO RCS - as req	8	
		Reconfigure for data collection when translation complete		
		When data collection complete		
		COAS PWR - OFF	15	
DP		VHF RNG - OFF	3	
		UVA Calibration, 17.6.6		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.6.5 UVA Deactivation		
DP		UVA LAMPS - OFF (verify)	230	
		UVA PWR - OFF		
		Close UVA COVER, 17.6.2		
		17.6.6 UVA Calibration		
		UVA/COAS Alignment, 17.6.3		UVA Calibration performed after UVA/COAS alignment and following each UVA operation for data accumulation.
		or UVA Operation, 17.6.4		
CP		SYS TEST - 1L	101	
DP		VHF RNG - OFF (verify)	3	
		Mnvr off tgt - verify		Vehicle +X axis about 10° above Soyuz and away from earth.
		pnl 101 meter cycling		
		Calibration		
	a.	Lamps on - covers open (30 sec)		
		UVA LAMPS - ON (verify)	230	
		UVA COVER - OPEN (verify)		
	b.	Lamps on - cover closed (30 sec)		
		UVA COVER - CLOSE		
	c.	Lamp off - cover closed (30 sec)		
		UVA LAMPS - OFF		
	d.	Lamps off - cover open (30 sec)		
		UVA COVER - OPEN		
		17.6.7 Disconnect Drag Thru Cable		Drag thru removed and stowed in preparation for CSM/DM separation.
		Verify		
		cb UVA EXP MNB - open		
		cb UVA COVER MNB - open		
		UVA PWR - OFF		
		UVA LAMPS - OFF		
		UVA COVER - ctr		
		UVA COVER tb - gray		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Remove drag thru cable from J1 panel 230. Install J1 dust cap. Pass cable thru tunnel for stowage in DM.	230	
	17.7	Not Applicable		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.8 STRATOSPHERIC AERSOL MEASUREMENT (SAM)		MA-007. Measures the concentration and vertical distribution of aerosols in the stratosphere.
		17.8.1 SAM Installation		
		Remove SAM from launch stowage and install on dovetail hard mount at RH side window with optic 90° to window plane. Remove J1 and J2 dust caps		
		Obtain SAM coax & pwr cables from stowage. Remove & stow cable dust caps		
DP		Conn coax connector P2 to J2 on SAM (TBD to TBD)	SAM	
		Conn pwr cable connector P1 to J1 on SAM (TBD to TBD)		
		Route P79 end of coax & P2 end of pwr cable to pnl 227		
		Verify		
		cb EXP PWR A - open	5	
		SCI PWR - OFF	227	
		Remove J79 and J85 dust caps, pnl 227		
		Conn coax P79 to (SAM) J79 at pnl 227 (TBD to TBD). Conn pwr cable P2 to J85 on pnl 227 (TBD to TBD)		
		17.8.2 SAM Operation/Data Collection		
		G&C System Prep, 17.2		
		SAM Activation		
		Verify SAM Installation, 17.8.1		

SAM OPERATION/DATA COLLECTION

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	cb EXP PWR A - close	5	
	SCI PWR - on (up)	227	
	SAM ind lt - on	SAM	
	Establish SAM sun LOS orient (P20) opt 1, 10.2.1 (N78 - Gamma = 57.50°, Rho = 31.10°)		Nominal SAM values.
	Mnvr to SAM att		Should be established with sufficient time for calibration and to damp rates to acceptable values prior to data collection.
	SAM Inflight Alignment Cal		Delta values obtained from SAM inflight calibration target.
CP	Key V06 N78E Load final Y & P	2,140	
	(P20) opt 1, 10.2.1 Mnvr to final SAM att Verify solar disc centered in SAM trgt ring		SAM photometer LOS should be within ±2.0° of sun at start of data collection. Verification that solar disc is centered (inside 2.0° circle) in SAM target ring for initial sunset data collection, will provide adequate onset alignment for time critical sunrise data collection.

	γ	ρ
Nominal	57.50	31.10
Delta	X.XX	X.XX
Final	XX.XX	XX.XX

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SAM CAL - ON (5-sec)	SAM	Calibration establishes the base and verifies proper installation and cable connection.
		Null att errors & rates just prior to inhibiting jets		Minimum error and rates required to ensure entire solar disc will remain within 10° FOV of photometer during approximate 3-minute data collection period.
AC				
	-00:30	CMC MODE - FREE	1	Inhibit RCS 30-seconds before data collection.
	00:00	Start Data Collection		
		When data collection complete		
		G&C Control - as reqd		
		SAM Deactivation		
DP		SCI PWR - OFF	227	
		SAM ind lt - off	SAM	
		17.8.3 SAM Removal		After final SAM data collection.
		Verify		
		cb EXP PWR A - open	5	
		SCI PWR - OFF	227	
		Remove coas & pwr cable connectors from J1 & J2 on SAM. Install J1 & J2 dust caps.	SAM	
		Remove coax & pwr cable connectors from J79 at pnl 227 & from J85 on pnl 227. Install J79 and J85 dust caps. Stow cables		Cables stowed in DM for CSM/DM separation.
		Remove SAM from dovetail hardmount & stow		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.9 MULTIPURPOSE ELECTRIC FURNACE SYSTEM (MEFS)		MA-010. Perform experiments on solidification, crystal growth, and other procedures involving phase changes in various types of materials.
	17.9.1 Furnace Evacuation		
	CAUTION Prior to evacuating furnace verify experiment sample cartridges are installed to preclude depressurizing DM thru vent system.		
(DM)	He Isol vlv - CLOSE (verify) He Press vlv - CLOSE (verify) He Vent vlv - CLOSE (verify) Furnace Isol vlv - OPEN Furnace Vent vlv - OPEN He Press vlv - OPEN, then CLOSE	MEFS	To vent DM O2/N2 from He injection cavity.
	17.9.2 Furnace He Injection		Helium injection time for each specimen cartridge to be subsequent to illumination of END status indicator or as directed by ground control.
	Furnace Vent vlv - CLOSE Furnace Isol vlv - CLOSE He Isol vlv - OPEN, then CLOSE He Press vlv - OPEN, then CLOSE		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.9.3 Sample Cartridge Prep		
(DM)	Furnace Vent vlv - CLOSE (verify) Furnace Isol vlv - CLOSE (verify) He Vent vlv - OPEN, then CLOSE He Press vlv - OPEN, then CLOSE	MEFS	Prior to initial sample processing, He Vent vlv & He Press vlv are opened to vent prelaunch He backfill in furnace.
	Retrieve sample cartridge from stowage Install sample cartridge in furnace		Sequence of sample cartridge processing defined in flight plan.
	For MA-060 Experiment Retrieve MA-060 pulser & control cable Install MA-060 pulser on furnace shroud cb GERM CRYS GROWTH MNA - open (verify) GERM CRYS GROWTH PWR - OFF Conn MA-060 cont cable connector P1 to J1 on pnl 862	862	MA-060, Germanium Crystal Growth.
	Furnace Evacuation, 17.9.1 Set MEFS Control Param		Set soak setting, soak period, cooldown rate, and RATE RATIO according to Flight Plan tabular data. Approach soak and RATE RATIO settings slowly in CW direction. If desired, turn CCW 1/4 turn and reapproach setting.

SAMPLE CARTRIDGE PREP

STA/T STEP	PROCEDURE	PANEL	REMARKS
(DM)	Select Furnace soak temp	MEFS	Selectable from 40°C to 1150°C depending upon specific sample cartridge requirements.
	CAUTION Do not select another soak temp during cool down period or ---- TBD.		
	Select Furnace soak period		Selectable from 1 to 64 hours, including manual, depending upon specific sample cartridge requirements.
	Select cool down rate		Selectable from passive to 0.6, 1.2, and 2.4°C/minute, depending upon specific sample cartridge requirements.
	Select RATE RATIO Select control thermocouple pair TC1/TC2		Selects active thermocouple pair for MEFS monitoring (ie., TC1 = H_1/C_1 & TC2 = H_2/C_2).
	TM - 1/2		Selects thermocouple pair for CSM PCM processing.
17.9.4	Sample Cartridge Initiate CAUTION Maintain spacecraft control mode that will minimize imparting accelerations to the experiment or disturbance of the sample solidification process will occur.		CSM overboard dumps are constrained from MEFS initiation through He injection.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	CMC (SCS) Min Impulse, 7.1.5 (7.1.2)		CSM minimum impulse single jet attitude control mode from initiation through He injection imparts minimum vehicle acceleration to the experiment.
	Verify Sample Cartridge Prep, 17.9.3		
DP	cb DM FURNACE/CRYS GROWTH (3) - close	274	
	For MA-060 Experiment		
(DM)	cb GERM CRYS GROWTH MNA - close	862	
	GERM CRYS GROWTH PWR - ON		
	POWER - ON	MEFS	
	START - START (mom)		
	17.9.5 Sample Cartridge Termination		
	FURNACE COOL lt - on (verify)		Touch temperature of furnace is less than 46°C.
	START - OFF		
	POWER - OFF		
	For MA-060 Experiment		
	GERM CRYS GROWTH PWR - OFF	862	
	cb GERM CRYS GROWTH MNA - open		
	MA-060 Pulser Cont Cable - disconn		
	Remove & stow pulser & cont cable		
	Equalize DM/furnace pressure		
	He Press vlv - close (verify)	MEFS	
	Furnace Isol vlv - OPEN		
	Furnace Vent vlv - OPEN (5 sec), then CLOSF		Purge He from furnace and lines.
	Furnace Isol vlv - CLOSE		

SAMPLE CARTRIDGE TERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
(DM)	He Press vlv - OPEN He Vent vlv - OPEN (5 sec), then CLOSE He Press vlv - CLOSE	MEFS	Repressurize furnace with DM atmosphere.
	17.9.6 Furnace Lamp Test		
	POWER - ON (verify) LAMP TEST - 1 STATUS LAMPS (8) - on LAMP TEST - 2 STATUS LAMPS (8) - on LAMP TEST - OFF POWER - OFF		
	17.9.7 Sample Cartridge Temp Verification		On board verification of MEFS sample cartridge process temperature.
	Sample Cartridge Initiate, 17.9.4 CARTRIDGE TEMP - HOT 1/HOT 2 (DIGITAL READOUT 0-1150°C) CARTRIDGE TEMP - COLD 1/COLD 2 (DIGITAL READOUT 0-200°C)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.10 ELECTROPHORESIS EXPERIMENT (EPE)		MA-014. ELECTROPHORESIS-GERMAN Experiment. Investigates possibilities of improved performance of free flow electrophoresis process in the absence of gravity.
		17.10.1 EPE Preparation		Verifies prelaunch EPE cooling of ECS secondary cooling loop and reconfigures for evaporative cooling prior to EPE Initiate.
DP		cb ELECTROPHORESIS (2) - close (verify)	274	
CP		FREEZER POWER - ON (verify)	EPE	Freezer power must be on at all times. Samples are in freezer.
		SAMPLE TEMP - 0-4°C (verify)		
		SUIT HT EXCH SEC GLY - BYP	382	
		SEC CAB TEMP vlv - OFF (ccw)	303	
		GLY TO RAD SEC vlv - BYP (verify)	377	
		SEC EVAP H2O CONT - AUTO	382	
		SEC EVAP H2O FLOW - AUTO	2	
		ECS IND sel - SEC		
		SEC COOL PUMP - AC2 (verify)		
		SEC GLY DISCH PRESS ind - 39-52 psig		
		SEC ACCUM QTY ind - 30-60%		
		SEC COOL EVAP - EVAP		
		SEC GLY EVAP STM PRESS ind -		
		0.09-0.14 psia (when boiling)		
		>0.14 psia (not boiling)		
		After 5 min		
		SEC GLY EVAP OUT TEMP ind - 40-45°F		For EPE Initiate, SEC GLY EVAP OUT TEMP must be 40-45°F.
		EPE COOLING - COOL (ccw) (verify)	165	

EPE PREPARATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.10.2 EPE Initiate		
	CAUTION Maintain spacecraft control mode that will minimize imparting accelerations to the experiment or acceleration induced sedimentation and thermal convection will occur.		
	CMC (SCS) Min Impulse, 7.1.5 (7.1.2)		CSM minimum impulse single jet attitude control mode during EPE operations imparts minimum vehicle accelerations to the experiment.
	Verify EPE Preparation, 17.10.1		
	CAUTION Initiation of sample is irreversible for that sample.		
	Remove samples (1, 2, or 3) from EPE receptacle or sample from MA-011 freezer and install in SAMPLE INLET		
CP	EPE POWER - ON	EPE	
	Verify Standby Status STANDBY lt - on FLUID NO/GO lt - out CHAMBER NO/GO lt - out RECORDER NO/GO lt - out		
	SEQUENCE START pb - push		
	Verify Sequence PRE RUN lt - on 200 sec		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	STEP 1 lt - on 100 sec STEP 2 lt - on 100 sec STEP 3 lt - on 150 sec POST RUN lt - on 150 sec SEQUENCE RESET pb - push STANDBY lt - on (verify) Remove sample from SAMPLE INLET, return to receptacle and install next sample into SAMPLE INLET		
	17.10.3 EPE Termination		
CP	EPE POWER - OFF	EPE	
	FREEZER POWER - OFF (only after last sample)		Freezer may be turned off following processing of last stored sample.
	SEC COOL EVAP - RSET 1 min, then off (ctr)	2	
	SEC EVAP H2O FLOW - OFF		
	SEC EVAP H2O CONT vlv - OFF	382	
	SEC COOL PUMP - off (ctr)	2	
	ECS IND sel - PRIM		
	SUIT HT EXCH SEC GLY - FLOW	382	
	SEC CAB TEMP vlv - as desired	303	
	EPE COOLING - BYPASS (cw) (Tool E)	165	Reference NASA Storage Document TBD.
	17.10.4 EPE Lamp Test		
DP	cb ELECTROPHORESIS (2) - close (verify)	274	
CP	FREEZER POWER - ON (verify)	EPE	
	EPE POWER - ON (verify)		
	STANDBY lt - on (verify)		
	LAMP CHECK - depress, then release all lts - on, then out (verify)		
	EPE POWER - OFF		
	STANDBY lt - out		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.11 ELECTROPHORESIS TECHNOLOGY EXPERIMENT (ETE)		MA-011. ELECTROPHORESIS - U.S.A. Experiment. Test new techniques for performing electrophoresis demonstrations in space flight.
		17.11.1 ETE Preparation		
		Obtain power cable from stowage. Remove & stow connector dust caps.		
		cb ETE AC2 (3) - open (verify)	274	
CP		ETE PWR - OFF (verify)	230	
		Conn power cable connector P2 to J2 on pnl 230 (TBD to TBD). Route P1 cable end across LEB to ETE		
		Conn P1 connector to J1 on ETE (TBD to TBD)	ETE	
		Lift ETE cover & lock upright		
		POWER - OFF (verify)		
		TEMP SELECT - OFF (verify)		
		MODE SELECT - OFF (verify)		
DP		cb ETE AC2 (3) - close	274	
CP		ETE PWR - ON	230	
		Obtain 70 mm HEDC, 80 mm lens, lens extdr, film pack, & IVL from stowage		
		Config camera & attach to ETE cover brkt	ETE	
		Obtain freezer from stowage & position near ETE		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.11.2 ETE Operation - Electrophoresis/ Isotachophoresis		
	CAUTION Maintain spacecraft control mode that will minimize imparting accelerations to the experiment or acceleration induced sedimentation and thermal convection will occur.		
	CMC (SCS) Min Impulse, 7.1.5 (7.1.2)		CSM minimum impulse single jet attitude control mode during ETE operations imparts minimum vehicle accelerations to the experiment.
	ETE Preparation, 17.11.1		
CP	Retrieve numbered column from ETE stowage comp't & place on thermoelectric cradle	ETE	ETE columns and sample slides are numbered and are required to be processed in order defined by flight plan: 1. Isotach of fixed red blood cells 2. Electro of fixed red blood cells 3. Electro of lymphocytes 4. Electro of kidney cells 5. Electro of kidney cells 6. Electro of lymphocytes 7. Electro of fixed red blood cells 8. Isotach of fixed red blood cells
	Clamp column in place. Attach fluid connection to each electrode		
	Connect electrical plug		
	Remove numbered sample slide from freezer & insert into column		

ETE OPERATION - ELECTROPHORESIS/ISOTACHOPHORESIS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		POWER - ON	ETE	
		If Electrophoresis, initiate cooling		
		TEMP SELECT - COOL		
		TIMER SELECT - 60		
		If Electrophoresis, verify cooling		
		COLUMN TEMP - +4°C		Approximately 10 minutes required to cool column to +4°C.
		CURRENT SELECT - HI (lymphocytes) or LO (kidney or red blood cells)		HI position for lymphocytes and LO position for kidney cells and red blood cells.
		Initiate photography		
		MODE SELECT - ELECTRO (electrophoresis) or ISOTACH (Isotachophoresis)		Conduct electrophoresis or isotachophoresis for 60 minutes. Timer activates audible signal at completion.
		Observe & RCD position of electrophoresis bands or isotachophoresis bands		
		MODE SELECT - OFF		
		If Electrophoresis, perform freeze		
		THERMO SELECT - FREEZE 30 min, then OFF		Conduct freeze cycle for 30 minutes.
		POWER - OFF		
		Discontinue photography		
		Disconn electrical plug & remove fluid connections from each electrode		
		If Electrophoresis		
		Unclamp column & twist off each electrode		
		Place frozen column in freezer & place electrode ends in ETE stowage comp't		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If Isotachophoresis Unclamp column & return assembled column to ETE stowage comp't	ETE	
	17.11.3	ETE Termination		
		ETE PWR - OFF	230	
DP		cb ETE AC2 (3) - open	274	
CP		Disconnect power cable from ETE & from J2 on pnl 230. Restow	230	
		Return freezer to stowage		
		Disassemble camera equipt & return to stowage locations		
		Close ETE cover	ETE	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.12 LIGHT FLASH (LF)		MA-106. Obtains data on the visual light flash phenomenon. During 90 minute manned period of data recording, angle between astronaut LOS and zenith to remain constant within 5-degrees. Additionally, while in the South Atlantic Anomaly (SAA), Astro LOS will be parallel to the earths magnetic lines of force within 5-degrees, and in a direction away from earth. Period within the SAA expected to be ≈5-minutes.
	17.12.1 LF Preparation		
	Obtain Power/Control Logic box, detector amplifier boxes, cables, & masks from stowage		
	Position power/control logic box on center couch		
	Position detector amplifier boxes on right & left couch headframe		
	Interconn power/contr logic box, detector amplifier boxes, & mask assemblies. Cable connectors (TBD to TBD)		
CP	cb UTIL LEB MNB - open (verify)	5	
	UTIL PWR - OFF (verify)	100	
	Conn power/contr logic box cable P1 connector to J5 on pnl 100 (TBD to TBD)		Three cables for each crewman (event, detector, mask cables).
	Config LF Data Recorder	LF	
	If manned LF operation		
	Don light weight headsets		Intra crew communication required during experiment data gathering. Monitoring crewman operates experiment equipment and accomplishes experiment related support functions.
	Config comm for voice record, 5.6.7		
	Obs crewmen ingress Rt & left couches		Observing crewmen identify light flash occurrences.
	Mon crewman install window shades & config for minimum ltg		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(P20) opt 5, mnvr to LF att, 10.2.1		Attitude for LF experiment defined as CSM in retrograde position with -Z axis rotated 60° from zenith (+X axis 30° from zenith), and XZ plane rotated 35° from orbital plane such that +X axis is rotated towards North. Ground track passes through SAA are NW to SE (descending passes).
		17.12.2 LF Operation (Manned)		Flight plan will define specific orbital time to initiate manned operation.
		Verify LF Preparation, 17.12.1		
		Obs crewmen don light tight masks		
		Mon crewman config exper pnls		
CP		DARK ADAPTATION (4) - OFF (verify)	LF	
		POWER - OFF (verify)		
		cb UTIL LEB MNB - close	5	
		UTIL PWR - on (up)	100	
		POWER - DARK ADAPT, Record time	LF	Monitoring crewman enters start time, dark adaptation levels, and phenomena visual detection in written logs. Integral tape recorder activated with LF power on.
		POWER lamp - on (verify)		
		TAPE RECORDER lamp - on (verify)		
		DARK ADAPTATION (4) - as req		Dark adaptation is determined by monitoring crewman by selection of crewman 1/crewman 2 for each level of dark adaptation (1 thru 4) over a 20 minute period.
		POWER - DET 1 for ~23 min, then 2, etc		Monitoring crewman positions detector select every 23 minutes, from 1 through 4 (total 92 minutes). Dark adaptation is periodically verified with DARK ADAPTATION.
		POWER - OFF		
		DARK ADAPTATION (4) - OFF		
		UTIL PWR - OFF	100	If unmanned operation immediately follows, utility power is left on.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.12.3 LF Operation (Unmanned)		Flight plan will define specific orbital time to initiate unmanned operation.
		Verify LF Preparation, 17.12.1		
		Position mask assemblies & detector amplifier boxes on Rt & left couch head rests		For unmanned operation, the interconnected mask assemblies and detector amplifier boxes are placed on the right and left couch head rests for data gathering.
		Position pwr/contr logic box on ctr couch		
CP		cb UTIL LEB MNB - close (verify)	5	
		UTIL PWR - on (up)	100	
		DARK ADAPTATION (4) - OFF	LF	
		POWER - DARK ADAPT, Record time		Monitoring crewman enter start time.
		POWER lamp - on (verify)		
		TAPE RECORDER lamp - on (verify)		
		POWER - OFF		As directed by ground control or flight plan.
		UTIL PWR - OFF	100	
		17.12.4 LF Disassembly		
		POWER - OFF (verify)	LF	
		UTIL PWR - OFF (verify)	100	
		cb UTIL LEB MNB - open	5	
		Disconn cable assy's from power/control logic box, detector amplifier boxes, mask assemblies, and CSM pnl 100, J5		
		Retrieve tape cassette from power/control box		
		Stow cassette, detector amplifier boxes, mask assy's & written logs for return stowage		
		Stow cable assys, & power/contr box for DM off loading		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.13 CRYSTAL GROWTH EXPERIMENT (CGE)		MA-028. Determines if crystals can be grown by diffusion through water in zero gravity conditions.
	CAUTION After activating experiment, maintain spacecraft control mode that will minimize imparting accelerations to the experiment or disturbance will occur of the reactor solution diffusion process leading to crystal formation.		
	17.13.1 Crystal Growth Activation		
CP	Open U4 locker doors & restrain in open position	U4	
	Open Reactor Chamber Valves	CGE	Six reactors, each having two valves. Lock frees key handle for valve opening.
	Rotate knurl knob lock (CCW) to free key handle on each end of reactor chamber		
	Rotate key handle -3 turns (CCW) to full open		Three revolutions stop to stop.
	Rotate knurl knob lock (CW) finger tight to secure valve in open position		
	Repeat proced for 5 other reactors		

CRYSTAL GROWTH ACTIVATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		If lock cannot be turned by hand Use spanner tool #(TBD) Rotate lock (CCW) to loosen If valve cannot be opened by hand	CGE	Spanner tool (TBD) in U4, used to unseat knurl knob locks or key handles.
		CAUTION Do not force key handle if lock is not backed off.		
		Use spanner tool #(TBD) Rotate key handle (CCW) ~3 turns to full open Rotate knurl knob lock (CW) to secure valve in open position		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Close U4 locker doors		Doors closed carefully to avoid imparting accelerations to the reactors.
		17.13.2 Photographic Observations		Reaction process to be photographed at 6 to 10 hour intervals three times per day following activation
		Obtain 35 mm camera from stowage		
		Open U4 locker doors & restrain in open position	U4	
		FLOOD LTS - full BRT (cw)	100	
		Adjust LH mirror to illuminate cryst growth reactors		
		Photograph reactors	CGE	
		Close U4 locker doors		
		Restow camera		
		FLOOD LTS - as req	100	
		17.14 Not Applicable		

STA/T STEP	PROCEDURE	PANEL	REMARKS
17.15	EARTH OBSERVATION		MA-136. Observe and photograph earth features.
	Configure G&C, 17.2		
	(P20) opt 5, 10.2.1		Provides required pointing for visual observations of earth features and for photographic mapping of targets of prime scientific interest, and other photographs in support of visual observations.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.16 SOLAR ECLIPSE		MA-148 (AS-4). Test new methods of studying solar corona and contamination surrounding spacecraft.
	Configure G&C, 17.2		
	(V49) mnvr to undock att, 8.3.4		$-X_{D6}$ axis toward sun. Attitude hold accuracy, P $\pm$ 0.7°, R $\pm$ 1.0°.
	Set DAC for photos Align COAS on docking trgt Configure RCS, 7.1.1 Configure Dock System for sep, 18.1.2		
CP	Verify Dock System lts	2	
	Undock (sunrise +1.5 min)		At undocking, $+Z_{A4}$ and $-Y_{C5}$ axes in plane defined by spacecraft, Earth and Sun.
	THC (4 jet) -X (-3 sec) Verify sep rate ~1 m/sec DAC - operate (~5 min)		
	THC - +X (null Xlation rates)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		18.0 APOLLO - SOYUZ OPERATIONS		
		18.1 DOCKING MODULE/SOYUZ DOCKING AND UNDOCKING - CM ACTIVE		
		This section contains the procedural requirements for docking and undocking with the Soyuz with the CM Docking System in the active mode. (See figure 18-1 for status lights logic.)		
		MANEUVERS		
		Deactivate glycol evaporator prior to 1000 ft from Soyuz		
AC		GLY EVAP STM AUTO - MAN	2	
		GLY EVAP STM INCR - INCR for 58 sec min		
		18.1.1 Docking With Soyuz, CM Active		At initiation of procedure, CSM shall be ±15 to 50 feet from Soyuz properly aligned and in formation flight.
	1	The following are req		
		CMC - on, 8.1.3		Provides G&N control capability.
		COAS - installed and calib, 13.1.8		
		SCS - on, 8.4.2		Provides SCS control capability.
		ISS - on & orient known, 8.1.3 & sec 14		
		RCS DAP load & activate, 8.2.1		Establishes G&N control capability as follows: CSM configuration, 4 quad translation (quads A, B, C, D - on).
		R1 - 611XX R2 - X1111	Noun 46 display	This maneuver should be performed in the following attitude and rate deadbands in either CMC or SCS control modes to simplify control task during docking.

	CMC	SCS
ATT DBD	±0.5° (R03)	±0.2° (MIN)
RATE DBD	+0.2°/sec (fixed)	±0.2°/sec (LO)
RATE CMD (RHC)	+0.5°/sec (R03)	±0.65°/sec

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Set SCS att controls		
AC		THC PWR - on (up)	1	Enables direct RCS coils for contingency takeover.
		RHC PWR DIR (both) - MNA/MNB		
		CMC MODE - HOLD		
		DBD/RATE - MIN/LO		
		ATT DBD - MIN		
		RATE - LO		
		LIM CYCLE - OFF		
		BMAG MODE (3) - ATT 1/RATE 2		
		MAN ATT (3) - RATE CMD		
		SC CONT - CMC		
		THC - ARMED		
		RHC (both) - ARMED		
	2	Verify control status for docking		
		COAS PWR - on (up)	15	
CP		EXT RENDZ LTS - SPOT	274	
DP		Docking System A		
		cb DS A IND LOGIC MNA - close		
		cb DS A IND PWR AC1 - close		
		cb DS A CONTROL BAT A - close		
		cb DS A MOTORS AC1 (3) - close		
		cb DM POWER (2) - close (verify)		
		Docking System B		
		cb DS B IND LOGIC MNB - close		
		cb DS B IND PWR AC2 - close		
		cb DS B CONTROL BAT B - close		
		cb DS B MOTORS AC2 (3) - close		

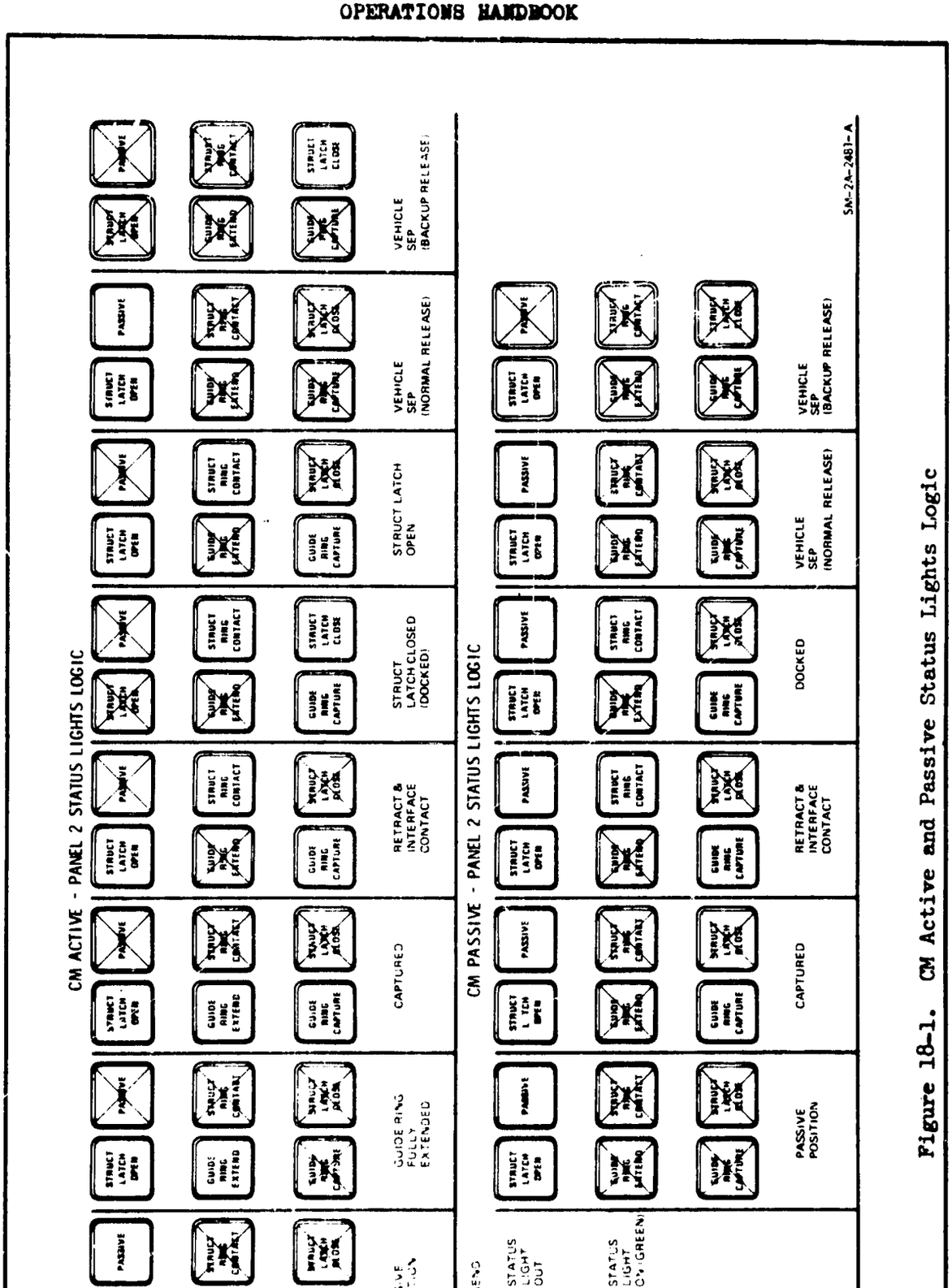


Figure 18-1. CM Active and Passive Status Lights Logic

18.1.1 DOCKING WITH SOYUZ, CM ACTIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	**Docking System Config for CM Active Docking**		
CP		PASSIVE lt - on (verify) STRUCT LATCH OPEN lt - on (verify)	2	Refer to CM ACTIVE/PASSIVE POS status lts, Fig 18-1.
		CAUTION Guide ring EXTND/RETR must be operated on system A or B only (single motor). Dynamic forces using two motors could create loads in the structure beyond design limits.		
		GUIDE RING A - EXTND		System A only to be used. Guide ring fully extended in approximately 60 seconds.
		GUIDE RING EXTEND lt - on		Indicates guide ring extended and ready for soft dock - GUIDE RING EXTEND lt on required for soft dock.
		PASSIVE lt - out		Refer to CSM ACTIVE/GUIDE RING FULLY EXTND status lts, Fig. 18-1.
		GUIDE RING A - off (ctr)		
	4	**Initiate Capture**		
AC		THC - initiate to close at 0.2 to 0.4 fps RHC - maintain min relative alignment angles with the Soyuz. Maintain angular rates $\leq$0.2 deg/sec		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		THC - initiate translation thrust (4 thrusters) $+X_{A5}$ direction after initial contact (0.5 sec max)	2	Stop translation thrust in the $+X_{A5}$ direction a maximum of 0.5 sec after capture. GUIDE RING CAPTURE lt indicates capture of all three latches.
CP		GUIDE RING CAPTURE lt - on		Refer to CM ACTIVE/CAPTURED status lts, Fig 18-1. GUIDE RING CAPTURE lt on, before initiating guide ring retract.
		Spacecraft alignment achieved		
	5	Initiate Guide Ring Retract GUIDE RING A - RETR GUIDE RING EXTEND lt - out		System A only to be used. Guide ring fully retracted in approximately 50 seconds.
		STRUCT RING CONTACT lt - on		Refer to CM ACTIVE/RETR & INTERFACE CONTACT status lts, Fig 18-1. Indicates interface seal contact (required for structural latch preload).
		GUIDE RING A - off (ctr)		2 seconds minimum after STRUCT RING CONTACT lt - on.
	6	Structural Latch Preload		
		CAUTION Structural latches CLOSE must be operated by system A or B only (single motor). Stalled gear box load using two motors could exceed system cable breaking strength.		
		NOTE STRUCT LATCH CLOSE lt may flicker due to delay in relay lockup.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		STRUCT LATCH A - CLOSE STRUCT LATCH OPEN lt - out	2	System A only to be used. Structural active latches (8) locked in approximately 8 seconds.
		STRUCT LATCH CLOSE lt - on		Indicates hard dock. Load cell verification provided in DM via selector switches (panel 856) and meters for an additional verification of structural latches locked. Refer to CM ACTIVE/STRUCT LATCH CLOSED (DOCKED) status lts, Fig 18-1.
		STRUCT LATCH A - off (ctr)		Guarded.
		CAUTION **Safing of Docking System must be performed, to prevent inadvertent undocking.**		
	7	Safe Docking System Docking System A		
DP		cb DS A CONTROL BAT A - open	274	
		cb DS A MOTORS AC1 (3) - open		
		Docking System B cb DS B CONTROL BAT B - open		
		cb DS B MOTORS AC2 (3) - open		
CP		GUIDE RING (2) - off (ctr) (verify)	2	
		STRUCT LATCH (2) - off (ctr) (verify)		Guarded.
DP		EXT RNDZ LTS - OFF (ctr)	274	
AC		COAS PWR - OFF	15	
	8	Postdocking pnl config Prepare for CSM/DM Docked operations, Appendix A		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		18.1.2 Undocking With Soyuz, CM Active		
	1	Perform prep for DM/Soyuz Undocking, SCS on, 8.4.2 Select desired displays, 7.2 Select SCS rate damping only, 7.1.4		
		Docking System A		
CP		cb DS A CONTROL BAT A - close	274	
		cb DS A MOTORS AC1 (3) - close		
		Docking System B		
		cb DS B CONTROL BAT B - close		
		cb DS B MOTORS AC2 (3) - close		
AC		MAN ATT (3) - RATE CMD	1	
		DBD/RATE - MIN/HI		
		ATT DBD - MIN		
		RATE - HI		
		THC PWR - ON (up)		
		RHC PWR NORM (both) AC/DC		
		RHC PWR DIR (both) - MNA/MNB		
		RHC, THC - ARMED		
		SC CONT - CMC		
		CMC MODE - AUTO		
		BMAG MODE (3) - ATT 1/RATE 2		
	2	Separation		
CP		Verify docking system		
		GUIDE RING CAPTURE lt - on	2	Verifies docking system ready for undocking. Refer to CM ACTIVE/STRUCT LATCH CLOSED (DOCKED) status lts, Fig 18-1.
		STRUCT LATCH CLOSE lt - on		
		STRUCT RING CONTACT lt - on		
		NOTE STRUCT LATCH OPEN lt may flicker due to delay in relay lockup.		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	STRUCT LATCH A - OPEN STRUCT LATCH CLOSE lt - out STRUCT LATCH OPEN lt - on	2	System A only to be used. Approximately 8 seconds. Refer to CM ACTIVE/STRUCT LATCH OPEN status lts, Fig 18-1.
	If STRUCT LATCH CLOSE lt - on & STRUCT LATCH OPEN lt - out STRUCT LATCH A - off (ctr) STRUCT LATCH B - OPEN If still STRUCT LATCH CLOSE lt - on & STRUCT LATCH OPEN lt - out STRUCT LATCH B - off (ctr) BACKUP PASSIVE (2) - RELEASE (hold ≈3 sec)		System A and B simultaneously. Guarded (momentary) - passive hook pulley is driven to the release position (≈2 to 3 seconds) releasing both the passive and active hooks. Power is also provided to the body latch release solenoids releasing the body mounted latches.
	CAPTURE LATCH (2) - RELEASE STRUCT RING CONTACT lt - out GUIDE RING CAPTURE lt - out		Refer to CM PASSIVE/VEHICLE SEP (BACKUP RELEASE) status lts, Fig 18-1.
	Verify Undocking & inform Soyuz crew		
	BACKUP PASSIVE - RESET then ctr (off)		Guarded. PASSIVE lt may flicker due to delay in relay lockup. Resets passive hooks and returns docking system to passive mode. The body mounted latches (3) return to lock position by spring actuation.
	PASSIVE lt - on		

UNDOCKING WITH SOYUZ, CM ACTIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		CAPTURE LATCH (2) - RELEASE GUIDE RING CAPTURE lt - out PASSIVE lt - on STRUCT RING CONTACT lt - out STRUCT LATCH A - off (ctr) Verify Undocking	2	Less than 1 second. System A and B simultaneously. Guide ring positions from active docked retract position to fully retracted (passive) position. Refer to CM ACTIVE/VEH SEP (NORM REL) status lts, Fig 18-1.
	3	Post Final Undocking Pnl config Docking System A		
DP		cb DS A IND LOGIC MNA - open cb DS A IND PWR AC1 - open cb DS A CONTROL BAT A - open cb DS A MOTORS AC1 (3) - open	274	
		Docking System B cb DS B IND LOGIC MNB - open cb DS B IND PWR AC2 - open cb DS B CONTROL BAT B - open cb DS B MOTORS AC2 (3) - open		
CP		Docking System Status lights (all) - out	2	

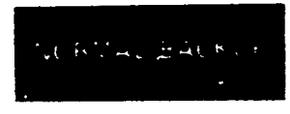
STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.2 DOCKING MODULE/SOYUZ DOCKING AND UNDOCKING - CM PASSIVE		
	This section contains the procedural requirements for docking and undocking with the Soyuz with the CM Docking system in the passive mode. (See Figure 18-1 for status lights logic.)		
	MANEUVERS		
	Deactivate glycol evaporator prior to 1000 ft from Soyuz GLY EVAP STM AUTO - MAN GLY EVAP STM INCR - INCR for 58 sec min	2	
	18.2.1 **Docking With Soyuz, Apollo DM Passive**		At initiation of procedure, CSM shall be ~15 to 50 feet from Soyuz properly aligned and in formation flight.
1 AC	The following are req CMC - on, 8.1.3 COAS - installed & calib 14.1.8 SCS - on, 8.4.2 ISS - on & orient known, 8.1.3 & sec 14 RCS DAP load & activate, 8.2.1 R1 - 611XX R2 - X1111		Provides G&N control capability. Provides SCS control capability. Establishes G&N control capability as follows: CSM configuration, 4 quad translation (quads A, B, C, D - on). This maneuver should be performed in the following attitude and rate deadbands in either CMC or SCS control modes to simplify control task during docking.

Noun 46 display

	CMC	SCS
ATT DBD	±0.5° (R03)	±0.2° (MIN)
RATE DBD	+0.2°/sec (fixed)	±0.2°/sec (LO)
RATE CMD (RHC)	+0.5°/sec (R03)	±0.65°/sec

DOCKING WITH SOYUZ, APOLLO DM PASSIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Set SCS att controls		
AC		THC PWR - on (up)	1	Enables direct RCS coils for contingency takeover.
		RHC PWR DIR (both) - MNA/MNB		
		CMC MODE - HOLD		
		DBD/RATE - MIN/LO		
		ATT DBD - MIN		
		RATE - LO		
		LIM CYCLE - OFF		
		BMAG MODE (3) - ATT 1/RATE 2		
		MAN ATT (3) - RATE CMD		
		SC CONT - CMC		
		THC - ARMED		
		RHC (both) - ARMED		
	2	Verify control status for docking		
		COAS PWR - on (up)	15	
DP		EXT RNDZ LTS - SPOT	274	
		Docking System A		
		cb DS A IND LOGIC MNA - close		
		cb DS A IND PWR AC1 - close		
		cb DS A CONTROL BAT A - close		
		cb DS A MOTORS AC1 (3) - close		
		cb DM POWER (2) - close (verify)		
		Docking System B		
		cb DS B IND LOGIC MNB - close		
		cb DS B IND PWR AC2 - close		
		cb DS B CONTROL BAT B - close		
		cb DS B MOTORS AC2 (3) - close		



STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Docking System Config for CM Passive Docking		
CP		STRUCT LATCH OPEN lt - on (verify) PASSIVE lt - on (verify)	2	Verifies guide ring retracted, body latches closed and passive hooks closed. Refer to CM PASSIVE/ PASSIVE POS status lts, Fig 18-1.
	4	Initiate Capture		
AC		THC - initiate to close at 0.2 to 0.4 fps RHC - maintain min relative alignment angles with the Soyuz. Maintain angular rates $\leq$ 0.2 deg/sec Initial contact - "Attitude hold - narrow dead band" THC - initiate translation thrust (4 thrusters) $+X_{A5}$ direction after initial contact, stop translation thrust (max of 0.5 seconds after capture).		
AC		GUIDE RING CAPTURE lt - on		Indicates Soyuz capture of all three body mounted latches. Refer to CM PASSIVE/CAPTURED status lts, Fig 18-1.
		Soyuz Guide Ring Retract	Soyuz	Soyuz crew transmit retract information to Apollo crew.
		STRUCT RING CONTACT lt - on	2	Indicates Soyuz guide ring has retracted and interface ring contact has been made. Refer to CM PASSIVE/RETR & INTERFACE CONTACT status lts, Fig 18-1.
		Soyuz initiate structural latch preload	Soyuz	Soyuz structural latch preload information transmitted to Apollo crew.

DOCKING WITH SOYUZ, APOLLO DM PASSIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION Safing of Docking System must be performed to prevent inadvertent undocking.		
	5	Safe Docking System		
		Docking System A		
DP		cb DS A CONTROL BAT A - open	274	
		cb DS A MOTORS AC1 (3) - open		
		Docking System B		
		cb DS B CONTROL BAT B - open		
		cb DS B MOTORS AC2 (3) - open		
		EXT RNDZ LTS - OFF		
AC		COAS PWR - OFF	15	
	6	Postdocking pnl config		
		Prepare for CSM/DM Docked operations Appendix A		
	18.2.2	Undocking With Soyuz, Apollo DS Passive		
	1	Perform prep for DM/Soyuz undocking		
		SCS on, 8.4.2		
		Select desired displays, 7.2		
		Select SCS rate damping only, 7.1.4		
		Docking System A		
DP		cb DS A IND LOGIC MNA - close	274	
		cb DS A IND PWR AC1 - close		
		cb DS A CONTROL BAT A - close		
		cb DS A MOTORS AC1 (3) - close		
		cb DM POWER (2) - close (verify)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Docking System B cb DS B IND LOGIC MNB - close cb DS B IND PWR AC2 - close cb DS B CONTROL BAT B - close cb DS B MOTORS AC2 (3) - close	27k	
AC		MAN ATT (3) - RATE CMD	1	
		[illegible]		
		[illegible]		
		[illegible]		
		[illegible]		
		Apollo crew ran undocking and inform Soyuz crew		Refer to CM PASSIVE WITH SOYUZ [illegible] status log. Fig 18-1.

UNDOCKING WITH SOYUZ, APOLLO DS PASSIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If Soyuz unable to perform undocking, inform Soyuz crew CM will undock.		
		BACKUP PASSIVE (2) - RELEASE (hold ≈ 3 sec)		System A and B simultaneously. Guarded (momentary) - passive hook pulley is driven to the release position (≈2 to 3 seconds) releasing both the passive and active hooks. Power is also provided to the body latch release solenoids releasing the body mounted latches.
		GUIDE RING CAPTURE lt - out		
		PASSIVE lt - out		
		STRUCT RING CONTACT lt - out		
		Verify undocking & inform Soyuz crew		Refer to CM PASSIVE/VEHICLE SEP (BACKUP RELEASE) status lts, Fig 18-1.
		BACKUP PASSIVE (2) - RESET then ctr (off)		Guarded. Passive lt may flicker due to delay in relay lockup. System A and B simultaneously (≈2 to 3 seconds). Resets passive hooks and returns docking system to passive mode. The body mounted latches (3) return to lock position by spring actuation.
		PASSIVE lt - on		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		STRUCT RING CONTACT lt - out	2	
		GUIDE RING CAPTURE lt - out		
	3	Post Final Undocking Pnl Config		Docking system (DS) post undocking panel configuration defines those circuit breakers requiring operation to deactivate the DS independent of mission consideration.
		Docking System A		
DP		cb DS A IND LOGIC MNA - open	274	
		cb DS A IND PWR AC1 - open		
		cb DS A CONTROL BAT A - open		
		cb MOTORS AC1 (3) - open		

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	Docking System B	274	
	cb DS B IND LOGIC MNB - open		
	cb DS B IND PWR AC2 - open		
	cb DS B CONTROL BAT B - open		
	cb DS B MOTORS AC2 (3) - open		
CP	Docking System Status lights (all) - out	2	

UNDOCKING WITH SOYUZ, APOLLO DS PASSIVE

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.3 ENVIRONMENTAL CONTROL/LIFE SUPPORT SYSTEM OPERATIONS		
	18.3.1 Docking Module Press Integrity Check		
1	CM/DM ΔP ind - ≈150 to 570 mm Hg	Hatch 2	
2	DM Pressurization		
	DM PRESS ISOL vlv - OPEN	901	
	DM PRESS vlv - INCR (Increase press to 550 mm Hg. Mon CM/DM ΔP ind to ≈292 mm Hg)	Hatch 2	Approximately 12 minutes are required to increase DM pressure from zero to 550mm Hg during initial pressurization.
	DM PRESS vlv - OFF		
	DM PRESS Isol vlv - CLOSE	901	
	Mon CM/DM ΔP ind time 5 min (no detectable decr allowed)		
3	CM/DM Press Equalization		
	DM VENT ISOL vlv - OPEN	900	
	DM VENT vlv - VENT		
	Mon CM/DM ΔP ind to zero	Hatch 2	About eight minutes are required to decrease pressure from 550 to 258mm Hg.
	DM VENT vlv - CLOSE	900	
	DM VENT ISOL vlv - CLOSE		
	Retrieve Tool B		
	Engage Tool B in Hatch PRESS EQUAL VALVE - OPEN	Hatch 2	Final equalization of pressure between the CM and DM is accomplished by opening the pressure equalization valve in hatch #2.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		18.3.2 DM Pressurization		
	1	Unlock Hatch, swing to the open position, 18.6.1	Hatch 2	
	2	Position oxygen hoses in DM retention device (snap in place) - AC/DP oxygen hoses		
CP	3	Check PPO_2 SYS TEST (2) - 1D SYS TEST ind - 1.5 vdc SYS TEST (2) - 1E SYS TEST ind - 1.5 vdc	101	PPO_2 should read 165mm Hg before DM ingress. Equivalent to 165mm Hg
	4	HIGH PRESS RELIEF vlv (2) - AUTO (verify)	821	
	5	O_2 PURGE PRESS RELIEF vlv - CLOSE (verify)	828	
	6	LOW PRESS RELIEF vlv - CLOSE (verify)		
	7	O_2 REG A vlv - ON O_2 REG B vlv - OFF EMER PRESS REG vlv - 1 PRESS TO TEST O_2 FLOW HI lt - on MASTER ALARM pb/lt - on, push	826 815	

DM PRESSURIZATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		O_2 REG B vlv - ON	828	
		O_2 REG A vlv - OFF		
		EMER PRESS REG vlv - 2	826	
		PRESS TO TEST		
		O_2 FLOW HI lt - on	815	
		MASTER ALARM pb/lt - on, push		
		O_2 REG A vlv - ON	828	
		EMER PRESS REG - BOTH	826	
	8	cb WALL HTRS (2) - open	815	
	9	Remove CM oxygen hoses from DM & stow in CM		
	10	Perform elect DM Config, 18.4.1 & 18.4.2		
	11	If docked (CM/SOYUZ), perform struct latch load cell test, 18.4.5 or 18.4.6		
	12	Release Hatch, swing to closed position & latch, 18.6.1	Hatch 2	
	13	Unlock and close Hatch PRESS EQUAL VALVE (rotate handle cw)		Handle must be in the yellow-band area (indicates a fully closed valve).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Cannot close PRESS EQUAL VALVE. Obtain Tool B & insert in external interface for additional leverage, hold depressed, & rotate ccw.	Hatch 2 CM side	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	14	Lock PRESS EQUAL VALVE	Hatch 2	
	15	Unstow HAND-HELD ABSOLUTE GAGE (HHAG), stow in panel 821 recess		For stowage, reference NASA document (TBD).
	16	DM N2 PRESS ISOL vlv - OPEN	824	
	17	DM N2 PRESS vlv - INCR (Pressurize to 490 mm Hg)		Required to pressurize the DM from 258 to 490 mm Hg on initial pressurization in approximately two minutes.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Unable to pressurize DM using DM N2		
		If DM N2 PRESS ISOL vlv or DM N2 PRESS vlv fails closed, use tunl 1 N2 vlvs		
CM		DM PRESS ISOL vlv - OPEN	901	
		DM PRESS vlv - INCR		CM/DM ΔP ind (Hatch 2, CM side) reading of 232 mm Hg is approximately 490 mm Hg in the DM.
DM		DM crew mon HHAG to 490 mm Hg		
CM		DM PRESS ISOL vlv - CLOSE		
		DM PRESS vlv - OFF		
DM		DM/CM ΔP ind - Mon 5 min for press change	Hatch 2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

DM PRESSURIZATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
18	HHAG - Mon to 490 mm Hg	821	Temporarily stow.
19	DM N2 PRESS vlv - OFF	824	
20	DM N2 PRESS ISOL vlv - CLOSE		
21	DM/CM ΔP ind - Mon 5 min for press change	Hatch 2	
	18.3.3 DM Depressurization		
	Adjust DM press to assure proper Soyuz atmosphere	824	Prior to depressurization, a Nitrogen adjustment to the total DM pressure is required to assure proper Soyuz atmosphere (340mm Hg).
	DM N2 PRESS ISOL vlv - OPEN		
	DM N2 PRESS vlv - INCR - Increase press as req		
	Mon press increase with HHAG	821	
	DM N2 PRESS vlv - OFF	824	
	Unlatch Hatch & swing to closed position, 18.6.1	Hatch 3	
	Close and lock Hatch PRESS EQUAL Valve		
	PRESS RELIEF VLV REF - VACUUM	824	
	DM/SOYUZ TUN VENT ISOL vlv - OPEN	803	
	DM/SOYUZ TUN VENT vlv - VENT		
	Vent Tunnel #2 to 260 mm Hg - Mon DM/SOYUZ ΔP ind ≈230 mm Hg	Hatch 3	Venting Tunnel #2 to 260mm Hg assures a positive pressure on Hatch #3 seals to prevent leakage.
	DM/SOYUZ TUN VENT ISOL vlv - CLOSE	803	
	DM/SOYUZ TUN VENT vlv - CLOSE		
	O2 PURGE PRESS RELIEF vlv - AUTO	828	
	O2 PURGE vlv - OPEN (ccw) for ≈4.5 min	824	Oxygen is added to insure PPO2 does not fall below acceptable limits during the depressurization sequence.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Unable to purge DM with O2 PURGE vlv		
	Don O2 face masks		
	MASK O2 vlv - ON (during DM depress & equalization with CM)	828	
	EMERG PRESS REG vlv - PRESS TO TEST (hold) until	826	
	O2 PART PRESS ind - 300 mm Hg & CABIN PRESS - 520 mm Hg	815	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Mon O2 PART PRESS ind - 300 mm Hg (shutoff at 280 mm Hg) & CABIN PRESS - 520 mm Hg	815	PPO2 sensor lags, consequently shutoff to be accomplished at 280 mm Hg (320 mm Hg maximum).
	O2 PURGE vlv - CLOSE (cw)	824	
	O2 PURGE PRESS RELIEF vlv - CLOSE	828	
	PRESS RELIEF VLV REF - DM	824	
	LOW PRESS RELIEF vlv - AUTO	828	
	PRESS RELIEF VLV REF - VACUUM	824	**Pressure in the DM will automatically vent overboard**
	Mon DM/CM ΔP ind to zero	Hatch 2	to a pressure between 290 and 321 mm Hg.
	Hatch PRESS EQUAL VALVE - Unlock & OPEN		Final equalization of pressure between the DM and Tunnel #1 is accomplished by opening Hatch #2 Equalization Valve.
	Unlock Hatch & swing to the open position 18.6.1		
	PRESS RELIEF VLV REF - DM		
	LOW PRESS RELIEF vlv - CLOSE	828	
	DM N2 PRESS vlv - OFF (verify)	824	
	DM PRESS ISOL vlv - CLOSE		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	CM Oxygen hoses - Install in DM retention device & snap in place (AC/DP oxygen hoses)		CM oxygen hoses are placed in the DM to provide circulation and remove CO2 for 10 to 15 minutes. Return hose is blocked by retention bracket.
	EMER PRESS REG vlv - OFF	826	
	O2 REG (2) - OFF	824	
	18.3.4 Tunnel #2 Integrity Check		
SC	OM Pressurize Tunnel #2 to 260 mmHg		OM (orbital module). Tunnel is initially pressurized by the SC (Soyuz crew) to perform Tunnel #2 and Hatch #4 pressure integrity check.
	Mon OM/DM ΔP ind TBD for change in ΔP	Hatch 4	Allowable delta-P TBD.
	OM Pressurize Tunnel #2 to 520 mmHg		Requires coordination with DM.
	Mon delta-P gage & Soyuz press indicator (5 min) for change in delta-P (TBD)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Tunl 2 leakage rate higher than TBD Number of transfers will be restricted within consumables available.		DM N2 supply tank may be depleted prior to completing the fourth transfer.
	Restrict total time hatches 3 & 4 are open		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Loss of tunl 2 pressure reading from DM Soyuz provides integrity check data for tunl 2 & hatch 3 DM pressurize & depressurizes tunl 2 using Soyuz Data		
AC		Mon Hatch DM/SOYUZ ΔP ind & HHAG for change in delta-P	Hatch 3 821	DM/OM compare mutual results.
AC/SC		DM/OM compare mutual results		
SC		Unlock Hatch PRESS EQUAL VALVE - Mon Delta-P gage to zero - Open & secure Hatch #4	Hatch 4	
AC		DM N2 PRESS vlv - INCR (Increase press as req)	824	
		DM N2 PRESS vlv - OFF		
		Unlock Hatch PRESS EQUAL vlv - Mon DM/SOYUZ ΔP ind to zero - Open & secure Hatch, 18.6.1	Hatch 3	
		18.3.5 Tunnel #2 Pressurization		Second transfer through fourth transfer. Pressure equalization valve is just cracked to allow Tunnel #2 to be pressurized to 490 mm Hg if required.
		Pressurize Tunnel #2 to 260 mm Hg		
		Mon Hatch DM/SOYUZ ΔP ind	Hatch 3	
		PRESS EQUAL VALVE - CLOSE		
		Mon Hatch DM/SOYUZ ΔP ind (2 min)		

TUNNEL #2 PRESSURIZATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	PRESS EQUAL vlv - open		
	Equalize press between DM & Tunnel #2		Equalizes DM/tunnel pressure to approximately 440mm Hg.
	Mon Hatch DM/SOYUZ ΔP ind to zero		
	Verify DM/tunnel press with HHAG 440 mmHg		
	DM PRESS vlv - INCR, incr press to 490 mm Hg	901	
	Mon press increase with HHAG		
	DM PRESS vlv - OFF		
	Unlock and release Hatch, swing open & engage in hold, open latch, 18.6.1	Hatch 3	
AC/SC	DM/OM mon press levels & compare mutual results		
	DM N2 PRESS vlv - INCR (Incr press as req)	824	
	DM N2 PRESS - OFF		
SC	Unlock & open Hatch PRESS EQUAL VALVE	Hatch 4	
	Mon delta-P gage to zero - open & secure Hatch		
	Install & secure duct between DM & Soyuz		
	18.3.6 Tunnel #2 Depressurization and Hatch #3 Integrity Check		
	DM/SOYUZ TUNL VENT ISOL vlv - OPEN	803	
	DM/SOYUZ TUNL VENT vlv - VENT		
	DM/SOYUZ ΔP ind - (-470 mm Hg)	Hatch 3	Final transfer sequence raises DM pressure to 520 mm Hg ΔP gage minimum increments 25 mm Hg.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If unable to vent, Soyuz vent tunnel #2 to 0.0 mm Hg xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	DM/SOYUZ TUNL VENT ISOL vlv - CLOSE DM/SOYUZ TUNL VENT vlv - CLOSE	803	
	Monitor DM/SOYUZ ΔP ind for 5 min for detectable change	Hatch 3	
18.3.7	Face Mask Operation		
	Remove face mask from DM stowage containers (2) MASK O2 vlv - ON Don face mask	828	Push mask pushbutton for continuous flow; otherwise, mask is demand flow.
18.3.8	High DM CO2 Partial Pressure (>15 mm Hg)		Usually from unexpected extended stay time in DM or unexpected high metabolic rates.
	Don masks, 18.3.7		

HIGH DM CO2 PARTIAL PRESSURE (>15 MM HG)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.4 ELECTRICAL POWER SYSTEM		
	18.4.1 DM Ingress Config		Configure circuit breakers at launch such that DM systems required for rendezvous, status and thermal control are available without entering the DM.
	LIGHTING 1 - OFF (verify) **LIGHTING 2 - START (verify)** cb CABIN FAN DMA - close (verify) cb INST (2) - close (verify) cb **LIGHTING 1 - DMA - open (verify)** cb LIGHTING 2 - DMB - close (verify) cb VHF FM XCVR DMA - close (verify) cb WALL HTRS (2) - close (verify)	815	
	18.4.2 DM Occupied Config & C&WS Operational Check		
	LIGHTING 1 - OFF LIGHTING 2 - ON cb LIGHTING 1 - DMA - close cb CAUT/WARN DMB - close cb DM AUDIO/TV DMB - close cb UTILITY DMA - close cb SOYUZ POWER DMB - close cb DMA/DMB TIE - open (verify) cb WALL HTRS (2) - open (verify) C&WS Operational Check 02 c/w pb (3) - push 02 c/w lt (3) - on 02 FLOW Hi pb & 02 PP A pb - push (simultaneously)		TV may require both **LIGHTING** switches on. Reset master alarm after closing circuit breakers.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	MASTER ALARM pb/lt & tone - on MASTER ALARM pb/lt - push MASTER ALARM pb/lt & tone - out		
18.4.3	DM Vacant Config		
	LIGHTING 1 - START LIGHTING 2 - OFF (verify) cb CAUT/WARN DMB - open cb WALL HTRS (2) - close	815	Wall heaters (3) on only when DM unoccupied.
18.4.4	DM Jettison Config		
	UTILITY POWER - OFF TV CAMERA POWER - OFF AUDIO 2 POWER - OFF AUDIO 1 POWER - OFF All cbs open on panel 815 except cb LIGHTING 1 - DMA - close LIGHTING 2 - OFF LIGHTING 1 - START, ON	808 818 811 815	
18.4.5	Struct Latches Load Cell Test (CM Active)		Interface sealing may be performed normally when any six of the eight DM structural latch load cells indicate proper loads (CLOSE range).
	DOCK SYS A TEST SEL - STRUCT LATCH 1,3,5,7 DS A TEST ind - CLOSE range	856	
	DOCK SYS B TEST SEL-STRUCT LATCH 2,4,6,8 DS B TEST ind - CLOSE range		

STA/T STEP	PROCEDURE	PANEL	REMARKS
18.4.6	Struct Latches Load Cell Test (CM Passive)		Interface sealing may be performed normally when any six of the eight structural latch load cells indicate proper loads (PASSIVE range).
	DOCK SYS A TEST SEL - STRUCT LATCH 1,3,5,7	856	
	DS A TEST ind - STRUCT LATCH PASSIVE range		
	DOCK SYS B TEST SEL - STRUCT LATCH 2,4,6,8		
	DS B TEST ind - STRUCT LATCH PASSIVE range		
18.4.7	Docking System Passive Test (Systems A & B)		
	DOCKING SYS TEST SEL (2) - PASSIVE HOOKS		
	DS TEST ind (2) - CLOSE range		Indicates passive hooks (8) closed.
	DOCKING SYS TEST SEL (2) - BODY LATCHES		
	DS TEST ind (2) - CLOSE range		Indicates body latches (3) closed.
	DOCKING SYS TEST SEL (2) - GUIDE RING RETR		
	DS TEST ind (2) - CLOSE range		Indicates guide ring retracted.
	DOCKING SYS TEST SEL (2) - OFF		Erroneous indications on panel 2 displays and PCM are possible if switch is in any passive test position.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.5 TELECOMMUNICATIONS SYSTEM		
	18.5.1 DM Speaker Box Operation		
	AUDIO 2 POWER - ON	818	
	Speaker Box	860	
	POWER - ON		
	SIGNAL - on (up)		
	XMIT/I'COM - I'COM		
	VOLUME tw - as req (verify comm)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	No comm		
	Speaker Box		
	POWER - OFF		
	SIGNAL - OFF		
	AUDIO 2 POWER - OFF	818	
	Disconnect Speaker Box from receptacle		
	Connect Speaker Box to receptacle	811	
	AUDIO 1 POWER - ON		
	Speaker Box	860	
	POWER - ON		
	SIGNAL - on (up)		
	XMIT/I'COM - I'COM		
	VOLUME tw - as req (verify comm)		
	Still no comm		
	Speaker Box		
	POWER - OFF		
	SIGNAL - OFF		

DM SPEAKER BOX OPERATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	AUDIO 1 POWER - OFF	811	
	Disconnect Speaker Box 860 from receptacle & stow		
	Unstow Speaker Box 960		For stowage, reference NASA document (TBD).
	Connect Speaker Box to receptacle	818	
	AUDIO 2 POWER - ON		
	Speaker Box	960	
	POWER - ON		
	SIGNAL - on (up)		
	XMIT/I'COM - I'COM		
	VOLUME tw - as req (verify comm)		
	Still no comm		
	Speaker Box		
	POWER - OFF		
	SIGNAL - OFF		
	AUDIO 2 POWER - OFF	818	
	Disconnect Speaker Box from receptacle and stow	960	
	Unstow CCU (2) & control Head (2) & connect		
	Unstow light weight head set (2) & connect to CCU control head	Soyuz TB	TB (transfer bag).
	Connect CCU's to receptacle on audio pnls	818	
	AUDIO 2 POWER - ON (verify comm)		
	AUDIO 1 POWER - ON (verify comm)	811	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
18.5.2	DM TV Checkout		
	TBD		
18.5.3	TV Crew Transfers		
	TBD		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.5.4 Soyuz Operations		
1	16MM Data Acquisition Camera Initiation		
	Unstow 16MM DAC & associated cable	Soyuz TC	Transfer container.
	Attach cable to DAC	808	
	Remove dust cover from UTILITY POWER receptacle (J1)		
	Attach DAC cable to UTILITY POWER receptacle (J1)		
	UTILITY POWER - ON		
	Config DAC as req		
2	16MM Data Acquisition Camera Power Down		
	Configure DAC as req		
	UTILITY POWER - OFF		
	Detach DAC cable from UTILITY POWER receptacle (J1)		
	Replace dust cover on UTILITY POWER receptacle (J1)		
	Remove DAC power cable from DAC		
	Stow DAC & cable	Soyuz TC	
3	16MM Data Acquisition Camera Initiation Soyuz		
	Unstow DAC & cable	Soyuz TC	
	Attach power cable to DAC	961	
	Attach power cable to UTILITY POWER receptacle		
	cb SOYUZ POWER DMB - close	815	
	TV/UTILITY POWER - ON	961	
	Configure DAC as req		

STA/T STEP	PROCEDURE	PANEL	REMARKS
4	16MM Data Acquisition Camera Power Down Soyuz		
	cb SOYUZ POWER DMB - open	815	
	TV/UTIL POWER - OFF	961	
	Detach power cable from UTILITY POWER receptacle		
	Disconnect power cable from DAC		
	Stow DAC and power cable	Soyuz TC	
5	Soyuz Speaker Box Operation		
	Unstow speaker Box	960	For stowage, reference NASA document (TBD).
	Transfer Speaker Box to Soyuz		
	Connect Speaker Box cable to AUDIO 2 receptacle	961	
	cb SOYUZ POWER DMB - Close	815	
	AUDIO POWER - ON	961	
	Speaker Box	960	
	POWER - ON		
	SIGNAL - ON		
	XMIT/I'COM - I'COM		
	VOLUME tw - Adj & verify comm		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	No comm		
	AUDIO POWER - OFF	961	
	Disconnect Speaker Box Cable from AUDIO 2 receptacle		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Transfer to DM	DM	
	Stow Speaker Box		
	Unstow CCU (2), Control Head (2) & light weight head set (2) from D1 Connect & transfer to Soyuz		
	Connect CCU's to receptacles AUDIO 1 & 2	961	
	AUDIO POWER - ON, verify comm		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
6	VHF/FM terminate		
	cb VHF/FM XCVR DMA - open	815	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.6 MECHANICAL SYSTEMS		
	18.6.1 DM Hatch Opening (2 & 3)		
1	Opening DM Hatch from DM exterior Verify ΔP gage reads zero		No opening of DM hatch No. 3 is planned from the Soyuz side, however, a B tool is stowed on hatch No.2 & 3 and the capability exists.
	Retrieve tool B from hatch location Engage Tool B in PRESS EQUAL VALVE PRESS EQUAL VALVE - OPEN CM/DM ΔP ind (Hatch 2) or SOYUZ/DM ΔP ind (Hatch 3) reads zero (verify) Engage Tool B in hatch gear box Unlock & release hatch, rotating tool B ccw Swing hatch inward & engage in hold open latch		"Hold Open" retention devices are provided in the DM for hatches 2 and 3 which are hinged and open inward along the +Y axis.
2	Opening DM hatch from the DM interior Verify ΔP gage reads ≈zero PRESSURE EQUAL VALVE - unlock & OPEN		Final equalization between the DM and tunnels No. 1 and No. 2 is accomplished by opening the hatch equalization valve.
	DM/CM ΔP ind (Hatch 2) or DM ΔP ind (Hatch 3) reads zero (verify) Actv handle rel - Pull & Rotate Actv handle - pull to stop Actv handle sel - U (unlatch) Actv handle - push to stop		

NORMAL BACKUP

STEP/TASK	PROCEDURE	ITEM	REMARKS
	[illegible]		
	Hatch will not release, one or several latches not diametrically opposed have not unlatched Remove hinge pin pin Separate hatch from DM hatch ring at hinge point Place hatch as near to main [illegible] latches [illegible] to hinge - if all [illegible] lock [illegible] if [illegible] hatch open latch Hatch will not release - All diametrically opposed latches will not unlatch Retrieve DM tool kit - obtain tools W & 4 - snap together Remove DM hatch ring striker plates from unlatched latches Remove two (2) 3/16 inch & one (1) 1/4 inch torq-set screws from each striker plate Swing hatch inward & engage in hold open latch		For stowage, reference NASA document TED.
3	DM Hatch Closing (2 & 3) Closing DM hatch from DM interior Disengage hatch from hold open latch Swing hatch to closed position		

DM HATCH OPENING (2 & 3)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Verify hatch is firmly positioned against sealing surface		
	Actv handle rel - Pull & Rotate		To free active handle for operation.
	Actv handle - pull to stop		Handle should move ≈80°.
	Actv handle sel - L (latch)		
	Actv handle - push to stop		Handle should move ≈60° to engage latches.
	Verify gear box disconnect socket is opposite L mark on hatch		
	Actv handle sel - stow		
	Actv handle - push to stowed position		Actuator handle release automatically locks handle in stowed position.
	Push manual gear box lock (chrome tab)		Verifies gear box lock engaged
	Closing DM hatch from the DM exterior		Hatch No. 2 is the only DM hatch which is planned to be closed from the DM exterior. Tool B is, however, provided in Tunnel No. 2 if required.
	Disengage hatch from hold open latch		
	Swing hatch to closed position		
	Engage tool B in gear box socket		
	Pull hatch firmly against sealing surface		
	Rotate tool B cw		
	Remove and stow Tocl B		
18.6.2	DM/Soyuz Umbilical Installation and Removal		
1	Umbilical Installation		
	Open Umbilical Cover	Tunnel #2	
	Squeeze latch to release		
	Secure open with velcro		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Disconnect Umbilical Connector P1 from stowage receptacle - pull to remove		Grip connector ears or lanyard and pull.
	Remove dust cap from Soyuz receptacle J1 - grip cap collar and pull		
	Install dust caps on DM P1 stowage receptacle - align, depress cap body, & push to install		Self-locking.
	Attach connector P1 to receptacle J1, align, & push to connect		
	Install umbilicals P2 and P3 following the preceding steps		
	Release Umbilical Cover, close, & latch		
2	**Umbilical Removal**	Tunnel #2	
	Open Umbilical Cover, squeeze latch to release, secure open with velcro		
	Disconnect Umbilical Connector P1 from Soyuz receptacle J1 - pull to remove		Grip connector ears or lanyard and pull.
	Remove dust cap from DM P1 stowage receptacle - grip cap collar & pull		
	Install dust cap on Soyuz receptacle J1, align, & press cap body, & push to install		
	Attach connector P1 to DM P1 stowage receptacle, align, and push to connect		Self-locking.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Remove umbilicals P2 and P3 following the preceding steps Release Umbilical Cover, close, & latch		

19.0 ABORT PROCEDURES

During the ascent phase, an abort can be accomplished in an LES, RCS, or SPS mode. An abort in the LES mode is accomplished by utilizing the launch escape system, which has solid propellant motors mounted on a tower above the command module. During a normal mission, the launch escape tower is jettisoned approximately 17 seconds after second-stage booster ignition. After the launch escape tower is jettisoned, an abort can be accomplished in the RCS mode, or SPS mode, by first utilizing the service module RCS jets to translate away from the LV. The SPS engine will be utilized, on a MODE III and MODE IV abort, to place the CSM in the desired trajectory for landing (MODE III) or earth orbit (MODE IV).

19.1 LES ABORT MODES

An abort may be initiated automatically by the emergency detection system (EDS) when two LV engines fail, LV excessive rates are detected, breakup between IU and CSM, or manually when the commander's translation control is rotated to the full CCW position. Upon receipt of an abort signal, regardless of its source, the booster is cut off (if after T +40 seconds), the CM is separated from the SM, and simultaneous ignition of the launch escape and pitch control motors takes place. Firing of the pitch control motor is inhibited 61 seconds after lift-off. Cutoff of the booster engines is inhibited for the first 40 seconds after lift-off by circuitry in IU because of range safety restrictions. The LES motors provide thrust to propel the command module away from the launch pad or trajectory of the launch vehicle.

Certain events that occur during an abort are controlled automatically by controllers in the sequential events control system (SECS). The earth landing sequence controller (ELSC) contains high-altitude and low-altitude baroswitches. The opening of these baroswitches inhibit ELS operations and the closing initiates the operations. The high-altitude baroswitch controls automatic LES tower jettison, apex cover jettison, and drogue parachute mortar fire. The high-altitude baroswitch is designed to open at 38,500 feet and close at 24,000 feet. Because of venting lag, the high-altitude baroswitch will not open until 40,500 feet during ascent. In an abort initiated under 30,000 feet (low part of abort mode 1-B), the 24K feet baroswitch will remain closed and allow automatic LES tower jettison, apex cover jettison, and drogue parachute and main parachute

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deployment on a timed sequence controlled by time-delay relays. On an abort initiated between 30,000 feet and 2 minutes 46 seconds, automatic LES tower jettison, apex cover jettison, and drogue parachute deployment are delayed until the command module descends to the closing altitude of the high-altitude baroswitch (24,900 to 21,500 feet).

The low-altitude (10K') baroswitch is closed at 10,000 feet, open at 18,000 feet. Opening of the low-altitude baroswitch will delay automatic deployment of the pilot-main parachutes until the command module descends to the closing altitude (10,950 to 9100 feet).

The LES abort is divided into three different modes as follows:

- Mode 1-A (launch pad to 61 seconds)
- Mode 1-B (61 seconds to 1 minute 48 seconds)
- Mode 1-C (1 minute 48 seconds to LES tower jettison)

During a Mode 1-A abort, CM RCS oxidizer automatically dumps overboard through an outlet in the aft heat shield. CM RCS fuel automatically dumps overboard through a similar outlet in the aft heat shield 5 seconds after oxidizer dump started, and requires about 11 seconds for depletion. CM RCS helium automatically begins purging the system 13 seconds after fuel dump started.

After the main parachutes disreef and a land impact is anticipated, during a Mode 1-B abort, manual initiation fires ten CM RCS jets to expend all propellant, followed by manually initiated helium expenditure through the jets to purge the system.

The auto abort capability due to two engines out or LV rates is switched off prior to SIB staging, and the crew must be ready to manually initiate an abort if these conditions arise. During a Mode 1-C abort (over 100K'), it is possible to jettison the LET and accomplish a normal entry provided certain conditions prevail. There must be sufficient TFF (100 sec) to perform the entry maneuver, a reliable attitude reference, and launch escape vehicle (LEV) rates must be within tolerance. If any of these conditions are not met, the LET must be retained to insure capture of the LEV with the heat shield oriented forward.

LES ABORT MODES

The altitude and velocity of the LEV is such that a possibility exists that it could enter the atmosphere canard and escape tower forward. The LEV would remain in this condition until descending below 100,000 feet and Mach 3.8. At this time a fast turnaround would occur which would be detrimental to crew safety. The crew will prevent canard forward capture by manual intervention shortly after abort initiation. A positive pitch rate of over 5° per second will be commanded and maintained until the canard starts trailing the CM upon descending to an altitude under 100,000 feet. Escape tower jettison and ELS activation will automatically occur at approximately 24,000 ft provided that the ELS AUTO sw is in the AUTO position.

The ELS decelerates the CM to a safe touchdown speed. Crew couch attenuators reduce the touchdown impact and start operating at approximately 15 G when they are unlocked. If they are not unlocked, a pin will shear in the lock at approximately 21 G and allow them to operate.

19.1 LES ABORT MODES

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STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.1.1 Mode 1A LES Abort (00:00 - 01:01)		
AC	1	Abort initiation	X	If manual backup required for any auto event after abort initiation it must be performed after LE motor burnout (abort T +00:05) because of high G environment during LE motor burn.
		auto or manual	X	
		THC - CCW	X	
			X	
		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
		X		
CP		X CM/SM SEP (both) - on		Guarded. On position is momentary. If abort is initiated with CM/SM SEP switches, subsequent events may require manual initiation and must be performed after LE motor burnout.
		X (up)		
		X		
		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
			X	
		BECO (auto after	X	Request ground
		T +00:40)	X	command BECO
			X	
00:00		Evnt Tmr rset and	X	
		counting up (auto)	X	
			X	
		CM/SM deadface (auto)	X	
			X	
		SM C/W lts - on	X	Because of switching transients, AC BUS 1 and 2 C/W lights will go on and MN BUS A and MN BUS B UV lights might go on if abort is initiated prior to T -01:00.
			X	
			X	
		MASTER ALARM pb/lt -	X	
		on	X	
			X	
AC		CM RCS press	X	
		(auto)	X	

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	RCS cont trnfr (auto)	X	MN BUS TIE switches are set to AUTO by T -1 hour and then to ON at T -01:15. DC main buses must be energized to provide power for RCS transfer, propellant dump, and purge.
	Entry bats to main buses (auto if abort initiated prior to T -01:00)	X	
	CM RCS oxidizer dump (auto)	X	
	CM RCS isol vlvs close (auto)	X	
00:00.1	CM/SM sep (auto)	X	CM/SM umbilical and tension ties severed.
	LE & PC motors fire (auto)	X	
00:01.8	CM/SM sep pyro deadface (auto)	X	
00:05	CM RCS fuel dump (auto)	X	
AC	If abort initiated with CM/SM SEP (both) or if backup req for any auto evnt	X	

19.1.1 MODE 1A LES ABORT (00:00 - 01:01)

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		X		
AC		X EVNT TMR RSET - RSET		RSET position is momentary.
		X		
		X EVNT TMR START - START		START position is momentary.
		X		
CP		X CM RCS PRESS - on (up)		Guarded. On position is momentary.
		X		
		X RCS TRNFR - CM		CM position is momentary.
		X		
DP		X MN BUS TIE (2) - on (up)		
		X (verify)		
		X		
CP		X Verify PRPLNT DUMP -		
		X AUTO		
		X		
		X CM RCS PRPLNT (both) - OFF		OFF position is momentary.
		X		
AC		X LES MOT FIRE pb - push		Guarded. Pitch control motor will not fire if LES MOT FIRE pushbutton used as backup 1.8 seconds after abort initiation.
		X		
		XXXXXXXXXXXXXXXXXXXXXXXXXXXX		
			X	
00:11		Canard deploy (auto)	X No backup req	CNRD DPLY pushbutton should not be used as backup on Mode 1A. Since adverse attitudes and critical timing is involved, canard deployment at wrong time could be detrimental to crew safety. Launch escape vehicle will operate satisfactorily without canard deployment.
			X on Mode 1A	
			X	
			X	
			X	
			X	
			X	
CP	2	C/W CSM - CM	X	**Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.**
			X	
	3	MASTER ALARM pb/lt -	X	
		push	X	
			X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC				
00:14		ELS logic arm (auto)		
		ELS AUTO - AUTO		
	4	ELS LOGIC - on (up)		Guarded.
		LES TWR jett (auto)		
CP		a. Docking ring sep		
		b. TWR attach nuts detonate	TWR JETT (both) - on (up)	Guarded. On position is momentary.
		c. SCS RCS disable	RCS CMD - OFF	OFF position is momentary.
		d. TWR jett motor fire		
AC				
00:14.4		Apex cover jett (auto)	APEX COVER JETT pb - push	Guarded.
00:16		Drogue chutes deploy (auto)	DROG DPLY pb - push (2 sec after apex cover jett)	Guarded.
		WARNING Below alidade marker on altimeter, MN DPLY pb - push		Alidade set for 3800 feet true altitude prior to launch.

MODE 1A LES ABORT (00:00 - 01:01)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
00:15		CM RCS helium purge (auto)	X CM RCS He DUMP X pb - push X CM PRPLNT DUMP - X on (up) X X CM PRPLNT PURG - X on (up)	Guarded. Guarded. CM PRPLNT DUMP and PURG switches provide alternate means of initiating He dump. Guarded.
CP ~10K'		CAB PRESS ind - 10 psia Main chutes & VHF recovery antenna deploy (auto)	X X X X X	2 Indication of main chute deploy altitude. Main parachutes disreef in ≈15 seconds.
	5	MN DPLY pb - push	X X	Guarded.
DP	6	Set up entry comm VHF ANT - RECY VHF AM A - SIMPLEX VHF BCN - ON	X X X X X	If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.
AC		Xmit voice (VHF AM) reporting Main chutes disreefed Splash error Crew status	X X X X X X X	Continue voice transmission until touchdown.
CP	7	Crew couch struts (4) - unlock	X X X	
DP	8	cb FLT/PL BUS BAT A, B & C (3) - close	X X X	Connects battery bus A, B, and battery C to flight and postlanding bus.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	9	cb FLT/PL BUS MNA - open	X X X	
	10	cb FLT/PL BUS MNB - open	X X X	
AC	11	cb SPS PITCH (2) - open	X X	
	12	cb SPS YAW (2) - open	X X	
3K'	13	rh CAB PRESS RELF vlv - DUMP (safety latch off)	X X X X	Ensures minimum cabin-to-ambient negative ΔP for landing impact.
	14	FLOOD FIXED - POST LDG	X X X X	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area.
	15	FLOOD DIM - 1 or 2	X X X X X	Position 1 provides power to two secondary floodlights, and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position and dc main buses deactivated.
CP	16	Verify RCS IND sel - CM 1	X X	Provides means of monitoring He pressure.
AC 800'	17	CAB PRESS RELF vlv (.) - CLOSE (safety latch off)	X X X X	Valves must be closed prior to touchdown to prevent water from entering CM.

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STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	18	ELS LOGIC - on (up) (verify)	X X X	
DP	19	CM RCS PRPLNT (both) - OFF	X X X	OFF position is momentary.
		CM RCS PRPLNT (both) - Op	X X X	Barber pole indicates at least one valve closed in each system.
AC	20	DIRECT O2 vlv - OPEN (CCW)	X X X	
DP	21	MN BUS TIE (2) - OFF	X X	Removes battery power from dc main buses.
		CAUTION	X X	
		MN BUS TIE switches must be left OFF to ensure that bats A, B & C are used to pwr postlanding sys cnly, & to prevent bat shorting caused by water entering CM feedthru connectors.	X X X X X X X X X X X X	
	22	cb BAT RLY BUS (2) - open	X X X	
	23	Postlanding check, sec 16	X X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.1.2 Mode 1B LES Abort (01:01 - 01:48)		
AC	1	Abort initiation auto or manual THC - CCW	X X X X X	If manual backup required for any auto event after abort initiation, it must be performed after LE motor burnout (abort T +00:05) because of high G environment during LE motor burn.
CP		CM/SM SEP (both) - on (up)	X X X X	Guarded. On position is momentary. If abort initiated with CM/SM SEP switches, subsequent events may require manual initiation and must be performed after LE motor burnout.
		BECO (auto)	X	Request ground command BECO
00:00		Evnt Tmr rset & counting up (auto)	X X X	
		CM/SM deadface (auto)	X X	
		SM C/W lts - on	X X	
DP		MASTER ALARM pb/lt - on	X X X	
AC		CM RCS press (auto)	X X	
		RCS cont trnfr (auto)	X X	
00:00.1		CM/SM sep (auto)	X	CM/SM umbilical and tension ties severed.

19.1.2 MODE 1B LES ABORT (00:01 - 01:48)

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LE motor fire (auto)	X	
			X	
00:01		SCS/RCS enbl (auto)	X	
			X	
00:01.3		CM/SM sep pyro	X	
		headface (auto)	X	
			X	
		XXXXXXXXXXXXXXXXXXXXXXXXXX		
		X		
00:05		X If abort initiated with		
		X CM/SM SEP (both)		
		X or if backup req for		
		X any auto evnt		
		X		
		X EVNT TMR RSET - RSET		RSET position is momentary.
		X		
		X EVNT TMR START - START		START position is momentary.
		X		
CP		X CM RCS PRESS - on (up)		Guarded. On position is momentary.
		X		
		X RCS TRNFR - CM		CM position is momentary.
		X		
AC		X LES MOT FIRE pb - push		Guarded.
		X		
CP		X RCS CMD - ON		ON position is momentary.
		X		
		XXXXXXXXXXXXXXXXXXXXXXXXXX		
			X	
AC			X	
00:11		Canard deploy (auto)	X	CNRD DPLY pb - push
			X	(hold for 3 sec)
CP	2	C/W CSM - CM	X	Extinguishes all SM C/W lights and allows CM RCS
			X	lights to function.

MODE 1B LES ABORT (00:01 - 01:48)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	3	MASTER ALARM pb/lt - push		
AC				
00:14		ELS logic arm (auto)	ELS LOGIC - on (up)	Guarded.
		ELS AUTO - AUTO		
24K'		LES TWR jett (auto)		
CP		a. Docking ring sep		
		b. TWR attach nuts detonate	TWR JETT (both) - on (up)	Guarded. On position is momentary.
		c. SCS RCS disable	RCS CMD - OFF	OFF position is momentary.
		d. TWR jett mot fire		
AC		Apex cover jett (auto)	APEX COVER JETT pb - push	Guarded.
		Drogue chutes deploy (auto)	DROG DPLY pb - push (2 sec after apex cover jett)	Guarded.
23.5K'	4	Mon CAB PRESS ind - starts incr	If no incr by 17K' rh CAB PRESS RELF vlv - DUMP (safety latch off)	No increase indicates cabin pressure relief valve failure.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
			X If still no X incr X CAB PRESS DUMP X vlv - open X (CCW) X	
CP			X	
LOS'		CAB PRESS ind - 10 psia	X 2	Indication of main chute deploy altitude.
		Main chutes & VHF recovery ant deploy (auto)	X X X X	Auto deployment occurs between 10,950 feet and 9,100 feet. Parachutes disreef in ≈15 seconds.
AC	5	MN DPLY pb - push	X X	Guarded.
	6	rh CAB PRESS RELF vlv - DUMP (safety latch off)	X X X X	
		XXXXXXXXXXXXXXXXXXXXXXXXXXXX X X If CM PRPLNT DUMP req X X CAUTION X X CM PRPLNT DUMP should X be initiated immedi- X ately after main chute X disreefing. If main X or pyro bus lost, use X RHCs for burn, not CM X PRPLNT DUMP switch.		

MODE 1B LES ABORT (00:01 - 01:48)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		X CAB PRESS RELF vlv X (2) - CLOSE (safety X latch off) X X	If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW)	
		X CM PRPLNT DUMP - on X (up) (dump burn is X audible) X		Guarded.
CP		X RCS IND sel - CM 1 X CM RCS He PRESS X ind - decr X X X	RCS IND sel - CM 2 CM RCS He PRESS ind - decr If no decr or RCS jets not firing	
AC,CP		X X X X X X X	RHC (both) - Fire all RCS jets (except plus pitch) until prplnts are depleted	One RHC positioned to command plus yaw and roll (excluding plus pitch) and other RHC positioned to command minus yaw, pitch and roll.
		XXXXXXXXXXXXXXXXXXXXXXXXXXX	X	
DP	7	Set up entry comm VHF ANT - RECY VHF AM A - SIMPLEX VHF BCN - ON	X X X X X	If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.
AC		Xmit voice (VHF AM) reporting Position	X X X	Continue voice transmission until touchdown.

19.1.2 MODE 1B LES ABORT (00:01 - 01:48)

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Main chutes	X	
		disreefed	X	
		Splash error	X	
		Crew status	X	
			X	
CP	8	Crew couch struts (4) -	X	
		unlock	X	
			X	
	9	(P21) Ground track	X	
		determination	X	
			X	
		a. Key V37E 21E	X	
			X	
		b. FL V04 N06	X	
		Option code 00002	X	
		CMC assumed option	X	
		0000X	X	Initially set to 00001 (this vehicle).
		Verify	X	
		R2 = 00001	X	
		PRO	X	
			X	
		c. FL V06 N34	X	Initial display will contain zeros (present time).
		GET Lat Long	X	If not changed by astronaut, calculations will be
		00XXX. HRS	X	based on present time.
		000XX. MIN	X	
		0XX.XX SEC	X	
			X	
		Accept PRO	X	State vector integrated to desired time.
		Reject Key V25E	X	
		Load	X	
		desired	X	
		GET Lat	X	
		Long	X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	d.	FL V06 N43 X Lat (+North) X XXX.XX DEG X Long (+East) X XXX.XX DEG X Alt XXXX.X NM X X		Altitude above launch pad radius. At this point, alt/10, VI, and gamma available by keying N73E.
		XXXXXXXXXXXXXXXXXXXXXXXXXX		
		X X If PRPLNT DUMP/BURN X when dump burn X complete X		Both CM RCS LOGIC and CM PRPLNT DUMP switches must be on to power CM PRPLNT PURG switch.
AC		X CM PRPLNT PURG -	CM RCS He DUMP pb -	Guarded. CM RCS He DUMP pushbutton should be used to
		X on (up) (purge	push	initiate purge following normal dump operation if CM
AC,CP		X audible)	If RHC (both) used	PRPLNT PURG switch fails to initiate purge. Visual
		X	for prplnt	fire from RCS engine nozzle extension surfaces after
		X	dump burn	burn to depletion and during purge is expected and
		X		normal.
		X		
		X	RHC (both) -	One RHC positioned to command plus yaw and roll
		X	Fire all jets	(excluding plus pitch) and other RHC positioned to
		X	(except plus	command minus yaw, pitch and roll.
		X	pitch)	
		X		
AC		X CAB PRESS RELF vlv	If CAB PRESS DUMP	
		X (2) - BOOST/ENTR	vlv used to	
		X (safety latch off)	equalize ΔP, CAB	
CP		X	PRESS DUMP vlv -	
		X	open (CCW)	
		XXXXXXXXXXXXXXXXXXXXXXXXXX		

19.1.2 MODE 1B LES ABORT (00:01 - 01:48)

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STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	10	cb FLT/PL BUS BAT A, B & C (3) - close	X X X	Connects battery bus A, B, and battery C to flight and postlanding bus.
	11	cb FLT/PL BUS MNA - open	X X X	
	12	cb FLT/PL BUS MNB - open	X X X	
AC	13	cb SPS PITCH (2) - open	X X	
	14	cb SPS YAW (2) - open	X X	
		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
		X		
		X If PRPLNT DUMP/BURN		
		X performed		
3K'		X rh CAB PRESS RELF vlv -		Ensures minimum cabin-to-ambient negative ΔP for
		X DUMP (safety latch		landing impact.
		X off)		
		X		
		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
			X	
AC	15	FLOOD FIXED - POST LDG	X X X X	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area.
	16	FLOOD DIM - 1 or 2	X X X X	Position 1 provides power to two secondary floodlights, and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position after dc main buses deactivated.

MODE 1B LES ABORT (00:01 - 01:48)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
800'	17	CAB PRESS RELF vlv (2) - CLOSE (safety latch off)	X If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW)	Valves must be closed prior to touchdown to prevent water from entering CM.
CP				
AC	18	ELS LOGIC - on (up) (verify)		Guarded.
CP	19	CM RCS PRPLNT (both) - OFF CM RCS PRPLNT tb (both) - bp		OFF position is momentary. Barber pole indicates at least one valve closed in each system.
AC	20	DIRECT O2 vlv - OPEN (CCW)		
DP	21	MN BUS TIE (2) - OFF CAUTION MN BUS TIE switches must be left OFF to ensure that bats A, B and C are used to pwr postlanding sys only, & to prevent bat shorting caused by water entering CM feed-thru connectors.		Removes battery power from dc main buses.
	22	cb BAT RLY BUS (2) - open		
	23	Postlanding check, sec 16		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.1.3 Mode 1C LES Abort (01:48 - 02:51)		
AC	1	Abort initiation (auto or manual) THC - CCW	X X X X	If manual backup required for any auto event after abort initiation it must be performed after LE motor burnout (abort T +00:05) because of high G environment during LE motor burn.
CP		CM/SM SEP (both) - on (up)	X X X X	Guarded. On position is momentary. If abort initiated with CM/SM SEP switches, subsequent events may require manual initiation and must be performed after LE motor burnout.
		BECO (auto)	X X	Request ground command BECO
00:00		Evnt Tmr rset & counting up (auto)	X X X	
		CM/SM deadface (auto)	X X	
		SM C/W lts - on	X X	
DP		MASTER ALARM pb/lt - on	X X X	
AC		CM RCS press (auto)	X X	
		RCS cont trnfr (auto)	X X	
00:00.1		CM/SM sep (auto)	X	CM/SM umbilical and tension ties severed.

MODE 1C LES ABORT (01:48 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LE motor fire (auto)	X	
			X	
00:01		SCS/RCS enable (auto)	X	
			X	
00:01.8		CM/SM sep pyro	X	
		deadface (auto)	X	
			X	
00:05		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
		X		
		X If abort initiated with		
		X CM/SM SEP (both) or if		
		X backup req for any		
		X auto evnt		
		X		
00:00		X EVNT TMR RSET - RSET		RSET position is momentary.
		X		
		X EVNT TMR START - START		START position is momentary.
		X		
CP		X CM RCS PRESS - on (up)		Guarded. On position is momentary.
		X		
		X RCS TRNFR - CM		CM position is momentary.
		X		
AC		X LES MOT FIRE pb - push		Guarded.
		X		
CP		X RCS CMD - ON		ON position is momentary.
		X		
		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
			X	
AC			X	
00:11		Canard deploy (auto)	X	CNRD DPLY pb - push
			X	Guarded.
CP	2	C/W CSM - CM	X	
			X	Extinguishes all SM C/W lights and allows CM RCS lights to function.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	3	MASTER ALARM pb/lt - push	X X X	
CP	4	Mon LEV status	X	
		GMBL LOCK lt - out	X	
		Abort apogee >30 NM	X	
		IMU gmbl lock can be avoided during manual cont	X X X	
		FDAIs agree	X X	
		If all above conditions are met, go to 5; otherwise go to 18	X X X X X	
	5	TWR JETT (both) - on (up)	X X X	Guarded. On position is momentary.
		a. Docking ring sep	X X	
		b. TWR attach nuts detonate	X X X	
		c. TWR jett mot fire	X X	
AC	6	Damp rates	X X	
	7	Mnvr to entry att R 0°, P 135°, Y 0°	X X	

MODE 1C LES ABORT (01:48 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	8	BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
			X	
	9	ATT DBD - MAX	X	
			X	
	10	Set up for CM RCS sys 1	X	
		AUTO RCS CM 1	X	
		(6) - MNA/MNB	X	
			X	
		AUTO RCS CM 2	X	
		(6) - OFF	X	
			X	
	11	BMAG MODE (3) - RATE 2	X	Prevents FDAI roll bug jump.
			X	
	12	EMS FUNC - ENTRY	X	
			X	
	13	EMS MODE - NORM	X	
			X	
	14	When .05 G lt - on	X	
		.05 G sw - on (up)	X	
			X	
	15	EMS ROLL - on (up)	X	
			X	
	16	Maintain full lift	X	
			X	
50K'	17	Go to Earth Landing,	X	
		sec 15	X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(LET descent from step 4)		
AC	18	Establish and maintain minimum 5 to 10°/sec + pitch rate with RHC	X X X X X	Pitchup rate of at least 5 deg/sec should be maintained until canard and LET begin trailing CM upon descending below entry interface. SCS ATT mode is rate command in all three axes at this time and RHC maximum command is 7 deg/sec.
30K'		ELS AUTO - AUTO ELS LOGIC - on (up)	X X	
CP 24K'		LES TWR jett (auto)	X X	
		a. Docking ring sep	X X	
		b. TWR attach nuts detonate	X TWR JETT X (both) - on (up) X	Guarded. On position is momentary.
		c. SCS RCS disable	X RCS CMD - OFF X	OFF position is momentary.
		d. TWR jett mot fire	X X	
AC		Apex cover jett (auto)	X APEX COVER JETT X pb - push X	Guarded.
		Drogue chutes deploy (auto)	X DROG DPLY pb - X push (2 sec after X apex cover jett)	Guarded.

MODE 1C LES ABORT (01:48 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC			X	
23.5K'			X	
	19	Mon CAB PRESS ind - starts incr	X	If no incr by 17K' rh CAB PRESS RELF vlv - DUMP (safety latch off)
CP			X	If still no incr CAB PRESS DUMP vlv - open (CCW)
10K'		CAB PRESS ind - 10 psia	X 2	Indication of main chute deploy altitude.
		Main chutes and VHF recovery ant deploy (auto)	X	Auto deployment occurs between 10,950 feet and 9,100 feet. Parachutes disreef in ≈15 seconds.
AC	20	MN DPLY pb - push	X	Guarded.
	21	CAB PRESS RELF vlv (2) - DUMP (safety latch off)	X	
DP	22	Set up entry comm	X	
		VHF ANT - RECY	X	
		VHF AM A - SIMPLEX	X	If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.
		VHF BCN - ON	X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Xmit voice (VHF AM)	X	Continue voice transmission until touchdown.
		reporting	X	
		Position	X	
		Main chutes	X	
		disreefed	X	
		Splash error	X	
		Crew status	X	
			X	
CP	23	Crew couch struts (4) -	X	
		unlock	X	
			X	
	24	(P21) Ground track	X	
		determination	X	
			X	
		a. Key V37E 21E	X	
			X	
		b. FL V04 N06	X	
		Option code 00002	X	
			X	
		CMC assumed option	X	
		0000X	X	Initially set to 00001 (this vehicle).
		Verify R2 =	X	
		00001	X	
		PRO	X	
			X	
		c. FL V06 N34	X	Initial display will contain zeros (present time).
		GET Lat Long	X	If not changed by astronaut, calculations will be
		00XXX. HRS	X	based on present time.
		000XX. MIN	X	
		0XX.XX SEC	X	
			X	

MODE 1C LES ABORT (01:48 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Accept PRO	X	State vector integrated to desired time.
		Reject Key V25E	X	
		Load	X	
		desired	X	
		GET Lat	X	
		Long	X	
			X	
		d. FL V06 N43	X	
		Lat (+North)	X	
		XXX.XX DEG	X	
		Long (+East)	X	
		XXX.XX DEG	X	
		Alt XXXX.X NM	X	Altitude is above launch pad radius. At this point, alt/10, VI, and gamma is available by keying N73E.
			X	
			X	
DP	25	cb FLT/PL BUS BAT A,	X	Connects battery bus A, B, and battery C to flight and postlanding bus.
		B & C (3) - close	X	
			X	
	26	cb FLT/PL BUS MNA -	X	
		open	X	
			X	
	27	cb FLT/PL BUS MNB -	X	
		open	X	
			X	
	28	cb SPS PITCH (2) - open	X	
			X	
	29	cb SPS YAW (2) - open	X	
			X	
3K'	30	FLOOD FIXED - POST LDG	X	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area.
			X	
			X	
			X	

19.1.3 MODE 1C LES ABORT (01:48 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	31	FLOOD DIM - 1 or 2	X X X X X	Position 1 provides power to two secondary flood-lights and position 2 provides power to two primary floodlights when FLOOD FIXED switch is in POST LDG position and dc main buses deactivated.
800' CP	32	CAB PRESS RELF vlv (2) - CLOSE (safety latch off)	X X X X X	If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW) — Valves must be closed prior to touchdown to prevent water from entering CM.
AC	33	ELS LOGIC - on (up) (verify)	X X X	Guarded.
	34	CM RCS PRPLNT (both) - OFF CM RCS PRPLNT tb (both) - bp	X X X X X	OFF position is momentary. Barber pole indicates at least one valve closed in each system.
	35	DIRECT O2 vlv - OPEN (CCW)	X X X	
DP	36	MN BUS TIE (2) - OFF CAUTION MN BUS TIE switches must be left OFF to ensure that bats A, B & C are used to pwr postlanding systems only, & to prevent bat ing caused by tering CM hru connectors.	X X X X X X X X X X X X X X	Removes battery power from dc main buses.

MODE 1C LES ABORT (01:48 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	37	cb BAT RLY BUS (2) - open	X X X	
	38	Postlanding check, sec 16	X X	

ABORT

19.2 RCS/SPS ABORT MODES II, III, IV

Mode II, III, and IV aborts are manually initiated and utilize the SM RCS or SM RCS and SPS engines to provide CSM/SIVB separation and translation. After separation and CSM stabilization, the abort possibilities separate into three categories.

- CM/SM separation and coast-to-landing site (MODE II).
- Shaped trajectory abort utilizing an SPS variable ΔV maneuver to correct the trajectory for the desired landing site in the Atlantic Recovery Area (MODE IIIA & IIIB).
- Abort-to-earth-orbit utilizing the SPS engine to attain earth orbital altitude and velocity (MODE IV).

RCS/SPS ABORT MODES II, III, IV

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.2.1 Mode II RCS Abort (02:51 to Mode IIIA or IV)		
AC	1	THC - CCW (4.0 sec min)	X X X X X	Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X EVNT TMR RSET - X RSET X EVNT TMR START - X START	RSET position is momentary. START position is momentary.
		BECO (auto) LV ENG 1 - on	X Request ground X command BECO	
		Direct ullage started (auto)	X DIR ULL pb - push X X X	If auto direct ullage present (THC-CCW), DIR ULL pb must not be actuated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto) LV ENG lt (1) - out	X CSM/LV SEP pb - X push	Guarded.
CP			X	
00:03.08		RCS/SCS enbl (auto) Key V82E FL V16 N44 Ha XXXX.X NM Hp XXXX.X NM TFF XXBXX MIN-SEC	X RCS CMD - ON X X X X X X	ON position is momentary. Calls R30 for meaningful display of N50. Apogee altitude. Perigee altitude. Time of free fall to 49.4 NM (300,000 ft).
AC	2	THC - ARMED, ctr, damp rates, then +X Check SM RCS tbs	X DIR ULL pb - push X X X	Automatic direct ullage terminated when THC returned to center.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Key N50F	X	
		Splash error	X	
		XXXX.X NM	X	Negative for undershoot, positive for overshoot.
		Hp XXXX.X NM	X	
		TFF XXBXX MIN-SEC	X	If TFF <100 seconds, maneuver-to-entry attitude must be initiated immediately and separation performed at entry attitude.
			X	
			X	
		If TFF <100 sec, go to 9	X	
AC			X	
00:24	4	Terminate +X trans	X	
			X	
	5	If TFF >2 min	X	
		Yaw 45° (out of	X	
		plane)	X	
		Start R&P mnvr to	X	
		entry att P 0°,	X	
		P 130°	X	
			X	
		If TFF <2 min	X	
		Start mnvr to	X	
		entry att	X	
		R 0°, P 130°, Y 0°	X	
			X	
	6	BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
			X	
	7	cb DOCK RING SEP (2) -	X	
		close (pull lanyard)	X	
			X	
CP		DOCK RING SEP (both) -	X	Guarded. On position is momentary. Jettisons docking ring.
		on (up)	X	
			X	

MODE II RCS ABORT (02:51 TO MODE IIIA OR IV)

STA/T	STEP	PROCEDURE	PANEL		REMARKS
CP	8	CM/SM SEP (both) - on (up)	X X		Guarded. On position is momentary. CM/SM umbilical and tension ties severed.
		CM/SM deadface (auto)	X		
		SM C/W lts - on	X		
DP		MASTER ALARM pb/lts - on	X X		
AC		CM RCS press (auto)	X X	CM RCS PRESS - on (up)	Guarded. On position is momentary.
		RCS cont trnfr - (auto)	X X	RCS TRNFR - CM	CM position is momentary.
		CM/SM sep (auto)	X X		CM/SM umbilical and tension ties severed (0.1 sec after CM/SM sep initiate).
		CM/SM sep pyro deadface (auto)	X X		
CP		C/W CSM - CM	X X		Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.
DP		MASTER ALARM pb/lt - push	X X X		
AC	9	Start yaw mnvr to entry att Y 0°	X X X X		
	10	ATT DBD - MAX	X X		
	11	Note TFF	X X		Maneuver-to-entry attitude must be completed prior to TFF = 0 seconds.
01:40			X		
	12	Mnvr to entry att R 0°, P 140°, Y 0°	X X X		BEF, heads down, full lift.

19.2.1 MODE II RCS ABORT (02:51 TO MODE IIIA OR IV)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	13	Set up for CM RCS sys 1	X	
		AUTO RCS CM 1	X	
		(6) - MNA or MNB	X	
		AUTO RCS CM 2	X	
		(6) - OFF	X	
			X	
AC	14	BMAG MODE (3) - RATE 2	X	Prevents roll bug jump when .05 G switch set to on.
			X	
	15	EMS FUNC - ENTRY	X	
			X	
	16	EMS MODE - NORM	X	
			X	
	17	When .05 G lt - on,	X	
		.05 G sw - on (up)	X	
			X	
	18	EMS ROLL - on (up)	X	
			X	
	19	Maintain full lift	X	
			X	
	20	Go to Earth Landing,	X	
		sec 15	X	

MODE II RCS ABORT (02:51 TO MODE IIIA OR IV)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.2.2 Mode IIIA SPS Abort (09:28 to Mode IIIB)		SPS posigrade burn to downrange recovery area.
AC	1	THC - CCW (4.0 sec min)	X	Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X EVNT TMR RSET - RSET	RSET position is momentary.
			X EVNT TMR START - START	START position is momentary.
		BECO (auto)	X Request ground command SIVB BECO	
		LV ENG 1 lt - on	X	
		Dir ullage started (auto)	X DIR ULL pb - push	If auto direct ullage present (THC-CCW), DIR ULL pb must not be activated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto) LV ENG 1 lt - out	X CSM/LV SEP pb - push	Guarded.
CP			X	
00:03.8		RCS/SCS enbl (auto)	X RCS CMD - ON	ON position is momentary.
		If not previously selected in boost	X	
		Key V82E N62E	X	
		VI XXXXX. FPS	X	
		Hdot XXXXX. FPS	X	
		Hpad XXXX.X NM	X	
			X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	2	THC - ARMED	X	
00:05		THC - neutral, damp	X DIR ULL pb - push	Automatic direct ullage terminated when THC
		rates, then +X	X	returned to center.
		Check SM RCS tbs	X	
		LV IND/GPI sw - GPI	X	
		If desired	X	
CP		Key N50E	X	
		Δh XXXX.X NM	X	
		HP XXXX.X NM	X	
		TFF XXBXX MIN-SEC	X	
AC			X	
00:24		Terminate +X trans	X	
			X	
	3	Mnvr to burn att	X	
		R 180°, P 355°, Y 0°	X	SEF, heads down.
			X	
		BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
		RATE - LO	X	
			X	
	4	Verify SPS GMBL ind	X	
		(2) = SPS GMBL tw (2)	X	
		settings	X	
		EMS MODE - NORM	X	
01:50		Ullage	X	
		THC - +X (IGN + 1 sec)	X DIR ULL pb - push	
		ΔV THRUST A - NORM	X	Guarded.
02:05		SPS THRUST - DIR ON	X No SPS IGN	Lever lock.
			X ΔV THRUST B -	
			X NORM	
			X	

MODE IIIA SPS ABORT (09:28 TO MODE IIIB)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		AC	X	
			X	If still no IGN
			X	THRUST ON pb -
			X	push
		IGN+1SEC RATE - HI	X	Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
			X	
			X	
		Terminate ullage	X	
			X	
	5	VC = desired value	X	
		(ΔR = -140 NM)	X	
	or	TFF = 1+40	X	
		ΔV THRUST (2) - OFF	X	Guarded.
			X	
		CP KEY REL	Y	
		FL V16 N44	X	
		Ha XXXX.X NM	X	
		Hp XXXX.X NM	X	
		TFF XXBXX MIN-SEC	X	
			X	
		If TFF >2 min	X	
		Yaw 45° (out of	X	
		plane) before	X	
		CM/SM sep	X	
			X	
		If TFF <2 min,	X	
		start mnvr to	X	Maneuver to entry attitude must be completed prior to TFF = 0 seconds.
		entry att	X	
		R 0°, P 120°, Y 0°	X	
			X	
		cb MNA & MNB BAT C (2) -	X	
		close	X	
			X	

19.2.2 MODE IIIA SPS ABORT (09:28 TO MODE IIIB)

ABORT

STA/T	STEP	PROCEDURE	PANEL		REMARKS
CP	6	CM/SM SEP (both) - on (up)	X X		Guarded. On position is momentary.
		CM/SM deadface (auto)	X		
		SM C/W lts - on	X		
		MASTER ALARM pb/lt - on	X X		
		CM RCS press (auto)	X	CM RCS PRESS - on (up)	Guarded. On position is momentary.
			X		
		RCS cont trnfr (auto)	X	RCS TRNFR - CM	CM position is momentary.
		CM/SM sep (auto)	X		
		CM/SM sep pyro deadface (auto)	X X X		CM/SM umbilical and tension ties severed (0.1 sec after sep initiate).
		C/W CSM - CM	X X		Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.
DP		MASTER ALARM pb/lt - push	X X X		
CP	7	cb DOCK RING SEP (2) - close (pull lanyard)	X X X		
		DOCK RING SEP (both) - on (up)	X X X		Guarded. On position is momentary. Jettisons docking ring.
AC		ATT DBD - MAX	X X		
	8	Note TFF	X		BEF, heads down, full lift.
		Complete mnvr to entry att	X X		
		Set up for CM RCS sys 1	X		
		AUTO RCS SEL CM 1 (6) - MNA or MNB	X X		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		AUTO RCS SEL CM 2	X	
		(6) - OFF	X	
		BMAG MODE (3) - RATE 2	X	
			X	
	9	EMS MODE - STBY	X	
			X	
		EMS FUNC - ENTRY	X	
		EMS MODE - NORM	X	
		Maintain full lift to	X	
		.05 G	X	
			X	
	10	When .05 G lt - on,	X	
		.05 G sw - on (up)	X	
		EMS ROLL - on (up)	X	
			X	
	11	**Fly max lift to 0.2 G**	X	
		then roll left 55 deg	X	
		(LV South)	X	
50K'		Go to Earth Landing,	X	
		sec 15	X	

Prevents roll bug jump when .05 G switch is set to on.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.2.3 Mode IIIB SPS Abort (Mode IIIA to Insertion)		SPS retrograde burn to downrange recovery area.
AC	1	THC - CCW (4.0 sec min)	X X X X X	Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X EVNT TMR RSET - X RSET X EVNT TMR START - X START	RSET position is momentary. START position is momentary.
		BECO (auto)	X Request ground X command SIVB X BECO	
		LV ENG 1 lt - on Dir ullage started (auto)	X X DIR ULL pb - push X X X	If auto direct ullage present (THC-CCW), DIR ULL pb must not be activated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto) LV ENG 1 lt - out	X CSM/LV SEP pb - X push	Guarded.
CP			X	
00:03.8		RCS/SCS enbl (auto) If not previously selected in boost Key V82E FL V16 N44 Ha XXXX.X NM Hp XXXX.X NM TFF XXBXX MIN- SEC	X RCS CMD - ON X X X X X X X X X X	ON position is momentary. Calls R30 for meaningful display of N50. Apogee altitude. Perigee altitude. Time of free fall to 49.4 NM (300,000 ft).

STA/T	STEP	PROCEDURE		PANEL	REMARKS
AC	2	THC - ARMED	X		
00:05		THC - neutral, damp	X	DIR ULL pb - push	Automatic direct ullage terminated when THC returned to center.
		rates, then +X	X		
		Check SM RCS tbs	X		
		LV IND/GPI sw - GPI	X		
			X		
CP	3	Key N50E	X		
			X		
		ΔR XXXX.X NM	X		Splash error (ΔR), negative for undershoot, positive for overshoot.
			X		
		Hp XXXX.X NM	X		
		TFF XXBXX MIN-SEC	X		If TFF <100 seconds, maneuver to entry attitude immediately.
			X		
AC			X		
00:24		Terminate +X trans	X		
			X		
	4	ΔR > -140 NM)	X		
		Mnvr to retro att	X		
		R 180, P 198, Y 0	X		BEF, heads up.
			X		
		Obtain retro update	X		
		BMAG MODE (3) - ATT 1/	X		
		RATE 2	X		
		RATE - LO	X		
			X		
	5	Verify SPS GMBL ind	X		
		(2) = SPS GMBL tw (2)	X		
		settings	X		
		EMS MODE - NORM	X		

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		X		
01:50	Ullage	X		
	THC - +X (IGN + 1 sec)	X	DIR ULL pb - push	
	ΔV THRUST A - NORM	X		Guarded.
		X		
02:05	SPS THRUST - DIR ON	X	No SPS IGN	Lever lock.
		X	ΔV THRUST B -	
		X	NORM	
		X		
		X	If still no IGN	
		X	THRUST ON pb -	
		X	push	
IGN+1SEC	RATE - HI	X		Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
		X		
		X		
	Terminate ullage	X		
		X		
6	VC = desired value	X		
	(ΔR = -140 NM)	X		
or	TFF = 1+00	X		
	ΔV THRUST (2) - OFF	X		
		X		
	If TFF >2 min	X		
	Yaw 45° (out of	X		
	plane) before	X		
	CM/SM sep	X		
		X		
	If TFF <2 min, start	X		
	mnvr to entry att	X		Maneuver to entry attitude must be completed prior
	R 0°, P 120°, Y 0°	X		to TFF = 0 seconds.
		X		
	cb MNA & MNB BAT C (2) -	X		
	close	X		

MODE IIIB SPS ABORT (MODE IIIA TO INSERTION)

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	7	CM/SM SEP (both) - on (up)	X X		Guarded. On position is momentary.
		CM/SM deadface (auto)	X		
		SM C/W lts - on	X		
		MASTER ALARM pb/lt - on	X X		
		CM RCS press (auto)	X X	CM RCS PRESS - on (up)	Guarded. On position is momentary.
		RCS cont trnfr (auto)	X X	RCS TRNFR - CM	CM position is momentary.
		CM/SM sep (auto)	X X		CM/SM umbilical and tension ties severed (0.1 sec after sep initiate).
		CM/SM sep pyro deadface (auto)	X X		
		C/W CSM - CM	X X		Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.
LP		MASTER ALARM pb/lt - push	X X X		
CP	8	cb DOCK RING SEP (2) - close (pull lanyard)	X X X		
		DOCK RING SEP (both) - on (up)	X X X		Guarded. On position is momentary. Jettisons docking ring.
AC		ATT DBD - MAX	X X		
	9	Note TTF	X		
		Complete rnvr to entry act	X X		BEF, heads down, full lift.
		Set up for CM RCS sys 1	X		
		AUTO RCS SEL CM 1	X		
		(6) - MIA or MIB	X		

19.2.3 MODE IIIB SPS ABORT (MODE IIIA TO INSERTION)

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL		REMARKS
AC		AUTO RCS SEL CM 2	X		
		(6) - OFF	X		
		BMAG MODE (3) - RATE 2	X		Prevents roll bug jump when .05 G switch is set to on.
			X		
	10	EMS MODE - STBY	X		
		EMS FUNC - ENTRY	X		
		EMS MODE - NORM	X		
		Maintain full lift to	X		
		.05 G	X		
			X		
	11	When .05 G lt - on,	X		
		.05 G sw - on (up)	X		
		EMS ROLL - on (up)	X		
			X		
	12	Fly max lift to 0.2 G	X	If TFF C/O	
		then roll left 55 deg	X	before ΔR = -140	
		(LV South)	X	at 0.2 G, roll	
			X	left 90° (LV South)	
			X		
50K'		Go to Earth Landing,	X		
		sec 15	X		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.2.4 Mode IV SPS Abort (09:41 to Insertion)		
AC	1	THC - CCW (4.0 sec min)	X X X X X	Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X EVNT TMR RSET - X RSET X EVNT TMR START - X START	RSET position is momentary. START position is momentary.
		BECO (auto)	X Request ground X command SIVB BECO	
		LV ENG 1 lt - on	X	
		Direct ullage started (auto)	X DIR ULL pb - X push X X	If auto direct ullage present (THC-CCW), DIR ULL pb must not be activated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto)	X CSM/LV SEP pb - X push	Guarded.
		LV ENG 1 lt - out	X X	
CP 00:03.8		RCS/SCS enbl (auto)	X RCS CMD - ON X	ON position is momentary.
	2	LV IND/GPI sw - GPI	X X	
AC	3	THC - ARMED, ctr, damp rates, then +X Check SM RCS tbs	X DIR ULL pb - push X X	Automatic direct ullage terminated when THC returned to center.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	Key V82E N62E	X	
		FL V16 N62	X	
		VI XXXXX FPS	X	
		Hdot XXXXX FPS	X	
		Hpad XXXX.X NM	X	
AC			X	
00:24	5	Terminate +X trans	X	
			X	
	6	If pitch profile burn	X	SEF, heads down. Slight movement of the GPI indicator
		mnvr to desired burn	X	(4) will be observed if SCS TVC (2) - RATE CMD.
		attitude	X	
			X	
	7	Obtain insertion update	X	
			X	
	8	BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
			X	
	9	RATE - LO	X	
			X	
	10	Verify SPS GMBL ind	X	
		(2) = SPS GMBL tw (2)	X	
		settings	X	
			X	
	11	EMS MODE - NORM	X	
			X	
	12	ΔV THRUST A - NORM	X	Guarded.
			X	
	13	Perform burn	X	-H DOT, burn ASAP; +H DOT, burn at 1:30.
		If Pitch Profile Burn	X	
AC		Start ullage (IGN	X	
		-15 sec)	X	

STA/T	STEP	PROCEDURE		PANEL	REMARKS
			X		
<1:30		SPS THRUST - DIR ON	X	If no SPS IGN	Lever lock.
			X	ΔV THRUST B-NORM	
			X	If still no SPS IGN	
			X	THRUST ON pb-push	
		SCS TVC PITCH-RATE CMD	X		
		RATE - HI	X		Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
			X		
			X		
		Terminate ullage -	X		
		IGN + 1 sec	X		
		BMAG MODE PITCH -	X		
		RATE 1	X		
		Fly H DOT to zero with	X		
		MTVC	X		
		Trim yaw with tw	X		
		Burn to desired VI	X	If H DOT >|100|	
			X	Key Rel to N44	
			X	(-H DOT) Burn	
			X	to Hp >70 NM	
			X	+ 4 sec	
			X	(+H DOT) Burn	
			X	to Ha >200 NM,	
			X	then Apogee	
			X	kick	
		Go to 14	X		
			X		
	or	If Fixed Att Burn	X		
01:50		Start ullage	X		

19.2.4 MODE IV SPS ABORT (09:41 TO INSERTION)

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
02:05		SPS THRUST - DIR ON	X If no SPS IGN X ΔV THRUST B-NORM X If still no SPS IGN X THRUST ON pb-push	
		Terminate ullage - IGN + 1 sec Burn to VC Go to 14	X If still no SPS IGN X and Mode IV <200 X fps or Apogee X Kick <400 fps X Burn RCS	
	14	ΔV THRUST (2) - OFF on VI or VC	X X X	
	15	SPS THRUST - NORM	X X	Lever lock.
	16	EMS MODE - STBY SECO +40 sec Status from ground	X X X X	
CP	17	SAFE ORBIT PRO (exit R30) Key V37E 00E	X X X X	
	18	Postorbital Insertion Check, 3.2	X X	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	20.0 UNDOCKED EMERGENCY PROCEDURES		
	Emergency procedures provide the crew with the necessary steps to quickly alleviate situations that have (or will) become both crew-hazardous and time-critical. These procedures require instant reaction on the part of the crew to prevent the conditions from becoming worse. In most instances the conditions are physically sensed by the crew rather than brought to their attention by the caution and warning system or voice communication from STDN.		
	20.1 PAD EMERGENCY PROCEDURES		
	20.1.1 Rapid Hatch Opening		To accomplish rapid hatch opening after engaging latches, hatch must be configured for rapid egress as shown in Cabin Closeout, 2.1.5.
CP 1	Gear box sel - UNLATCH (verify)	Side hatch	
2	Actr handle rel - push or squeeze		
3	Actr handle - opr (until hatch is unlatched)		Lock pin will be sheared. About 5 cycles of actuator operation will open hatch.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx x x If hatch fails to open GN2 ratchet handle - opr GN2 vlv handle - unlock & push (outbd) x x xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		20.2 UNDOCKED FLIGHT EMERGENCY PROCEDURES		
		20.2.1 Fire/Smoke in CM During Boost		
CP	1	CAB FAN (both) - OFF (verify)	2	
DP	2	Monitor EPS indicators for excess current Immediately remove pwr from affected bus to prevent further damage to critical systems	3	
	3	If in abort mode I or II SUIT COMPR 1 (or 2) - on good ac bus	4	
	4	If in abort mode III & affected bus is MNA (or B)		
AC		TVC GMBL DR (2) - 2 (or 1)	1	
AC DP		INV 1 (or 2) AC1 (or 2) - OFF INV 2 (or 1) AC1 (or 2) - on (up)	3	Powers both ac buses with inverter from good main bus.
AC	5	rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	
	6	Continue appropriate abort		
		20.2.2 Fire/Smoke in CM - Orbital Operations		
		a. Suited Crew		
CP		CAB FAN (both) - OFF (verify)	2	
DP		Monitor EPS indicators for excess current. Immediately remove pwr from affected bus to prevent further damage to critical systems	3	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SUIT COMPR 1 (or 2) - on good ac bus	4	Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels, closed compartments, and electrical fires.
		Fire extinguisher - use as appropriate		
		Fire out		
		WARNING Combustion products may be toxic. Smoke should be removed from cab per Contam in CM, 20.2.5 (step 3b), before removing helmets.		
		Fire persists		
		Dump cabin as follows		
AC		SUIT RETURN vlv - CLOSE (push) (verify)	380	
CP		EMER CAB PRESS sel - OFF (verify)	351	
AC		REPRESS PKG vlv - OFF (verify)	326	
ALL		PGA - visual integrity check		
AC,CP		rh CAB PRESS RELF vlv - DUMP (safety latch off) until	325	Provides controlled cabin dump until suit circuit pressure verified.
		CAB PRESS ind 3.0 psia, then	2	
		to BOOST/ENTR	325	
		SUIT PRESS ind - holding >3.5 psia (verify)	2	
AC CP		rh CAB PRESS RELF vlv - DUMP &/or CAB PRESS DUMP vlv - open (CCW)	325 Side hatch	
		CAB PRESS ind - 0.0 psia for 6 min	2	Time period is a function of equipment oxygen exposure and saturation level.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		rh CAB PRESS RELF vlv - NORM (safety latch on) & CAB	325	
CP		PRESS DUMP vlv - close (CW)	Side hatch	
		WARNING Do not repress cab until fire source removed. Reignition may occur with additional damage. If condition lasts longer than 10 minutes, gly circulation & temp cont must be re-established.		
	b.	Unsuited or Partially Suited Crew		
ALL		Don emer 02 mask (refer to Oper of Emer 02 Masks, 5.4.14)		
CP		CAB FAN (both) - OFF (verify)	2	
DP		SUIT COMPR (both) - OFF	4	
		Monitor EPS indicators for excess current. Immediately remove pwr from affected bus to prevent further damage to critical systems	3	
		Fire extinguisher - use as appropriate		Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels, closed compartments, and electrical fires.
		Fire out		
		WARNING Combustion products may be toxic. Smoke should be removed from cab per Contam in CM, 20.2.5 (step 3b), before removing 02 masks.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Fire persists		
ALL		Don PGA except helmet (refer to PGA Mode Changes, 5.4.6)		O2 connections red-to-red and blue-to-blue. Use O2 masks as long as possible.
AC		DIRECT O2 vlv - OPEN (CCW)	7	Purges suit inlet manifold, suit hoses, and PGA portion of suit circuit.
ALL		Remove emer O2 mask & don helmet		
CP		SUIT FLOW vlv (3) - FULL FLOW	300,301,302	
DP		SUIT COMPR 1 (or 2) - AC1 (or AC2)	4	
AC		DIRECT O2 vlv - close (CW)	7	
CP		EMER CAB PRESS sel - OFF	351	
ALL		PGA - visual integrity check		
AC		rh CAB PRESS RELF vlv - DUMP (safety latch off) until	325	Provides controlled cabin dump until suit circuit pressure verified.
CP		CAB PRESS ind 3.0 psia, then to BOOST/ENTR	2	
		SUIT PRESS ind - holding >3.5 psia (verify)		
AC		rh CAB PRESS RELF vlv - DUMP	325	
CP		&/or CAB PRESS DUMP vlv - open (CCW)	Side hatch	
		CAB PRESS ind - 0.0 psia for 6 min	2	Time period is a function of equipment oxygen exposure and saturation level.
AC		rh CAB PRESS RELF vlv - NORM (safety latch on) & CAB	325	
CP		PRESS DUMP vlv - close (CW)	Side hatch	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		WARNING **Do not repress cab until fire source removed. Reignition may occur with additional damage. If condition lasts longer than 10 minutes, gly circulation and temp cont must be re-established.**		
		20.2.3 Fire/Smoke in CM During Entry		
	1	CAB FAN (both) - OFF (verify)	2	
DP	2	Monitor EPS indicators for excess current. Immediately remove pwr from affected bus to prevent further damage to critical systems	3	
AC	3	RHC PWR DIR (both) - MNA/MNB, & maintain att if req	1	
	4	If affected bus is MNA		
DP		INV 1 AC1 - OFF INV 2 AC1 - on (up)	3	Powers both ac buses with inverter being powered from good dc main bus, providing ac power for suit compressors and SCS.
AC		Set up for CM/RCS sys 2 (1) AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (2) (6) - OFF AUTO RCS CM 2 (1) (6) - MNB	8	System 1 is normal and system 2 is redundant.

FIRE/SMOKE IN CM DURING ENTRY

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5	If affected bus is MNB		
DP		INV 2 AC2 - OFF INV 1 AC2 - on (up)	3	Powers both ac buses with inverter being powered from good dc main bus, providing ac power for suit compressors and SCS.
		Set up for CM/RCS sys 2 (1) AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (2) (6) - OFF AUTO RCS CM 2 (1) (6) - MNA	8	
AC	6	rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	
	7	Continue entry		
	20.2.4	Not Applicable		
	20.2.5	Contamination in CM		Types, sources, and amount of contamination are not defined. The very existence of contamination in CM is treated as an emergency.
ALL	1	Don emer 02 mask &/or PGA immediately (refer to Oper of Emer 02 Masks, 5.4.14 and PGA Mode Changes, 5.4.6)		
	2	Evaluate contam level, & isolate or correct source of contam		

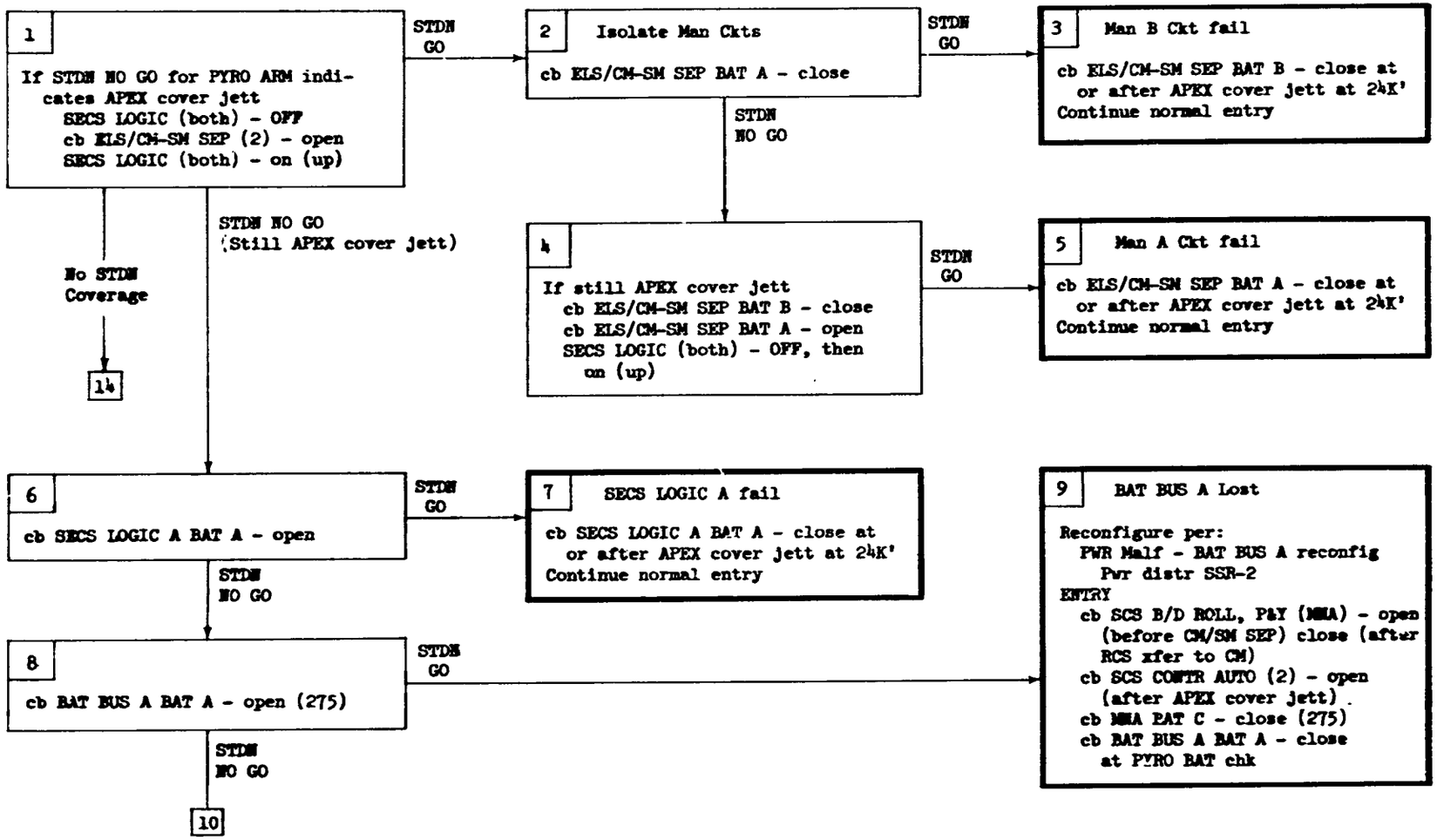
STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	If contam persists		
ALL		a. Accept contam level in cab		Slow removal of contamination accomplished with WASTE STOW valve (panel 252) in VENT position.
		Retain O2 mask or remain in PGA		
AC		If in PGA, adjust DIRECT O2 vlv	7	
CP		for SUIT CAB ΔP >2 in. H2O	2	
		b. Dump & repress cab		
ALL		Retain or don PGA (refer to PGA Mode Changes, 5.4.6)		
		PGA - visual integrity check		
		Perform CM Press Dump, 5.4.11		
		Perform CM Repress, 5.4.8		
	20.2.6	Contamination in Suit (Suited Crewman)		Contamination originates within suit circuit if, after purging with oxygen, contamination still present.
DP	1	SUIT COMPR 2 - AC1	4	
	2	SUIT COMPR 1 - OFF		
AC	3	DIRECT O2 vlv - OPEN (CCW) for 1 min, then close (CW)	7	
	4	If condition persists		
DP		SUIT COMPR 2 - OFF	4	
AC		DIRECT O2 vlv - close (CW)	7	
ALL		Doff helmet		
		Don emer O2 mask (refer to Oper of Emer O2 Masks, 5.4.14)		
		Determine contam cause		

CONTAMINATION IN SUIT (SUITED CREWMAN)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	20.2.7	**LET Fails to Jettison**		
	a.	Tower Legs Cut/No jett mot ign		
AC		LES MOT FIRE pb - push	1	Guarded.
		If tower jett successful		
CP		TWR JETT (both) - OFF (ctr)	2	Guarded.
		Continue mission		
		If tower jett unsuccessful		
		TWR JETT (both) - OFF (ctr)		Guarded.
		Report to STDN & go for orbit		
	b.	No Response to TWR JETT Switches		
		Verify the following		
AC		cb SECS ARM (2) - close	8	
		cb SECS LOGIC (2) - close		
		cb EDS (all) - close		
		SECS LOGIC (both) - on (up)		Lever lock.
		SECS PYRO ARM (2) - on (up)		Lever lock.
		EDS PWR - on (up)	7	
CP		TWR JETT (both) - on (up)	2	Guarded. On (up) position is momentary.
		If tower jett successful		
		TWR JETT (both) - OFF (ctr)		
		Continue mission		
		If tower jett unsuccessful		
		TWR JETT (both) - OFF (ctr)		
		Report to STDN & go for orbit		

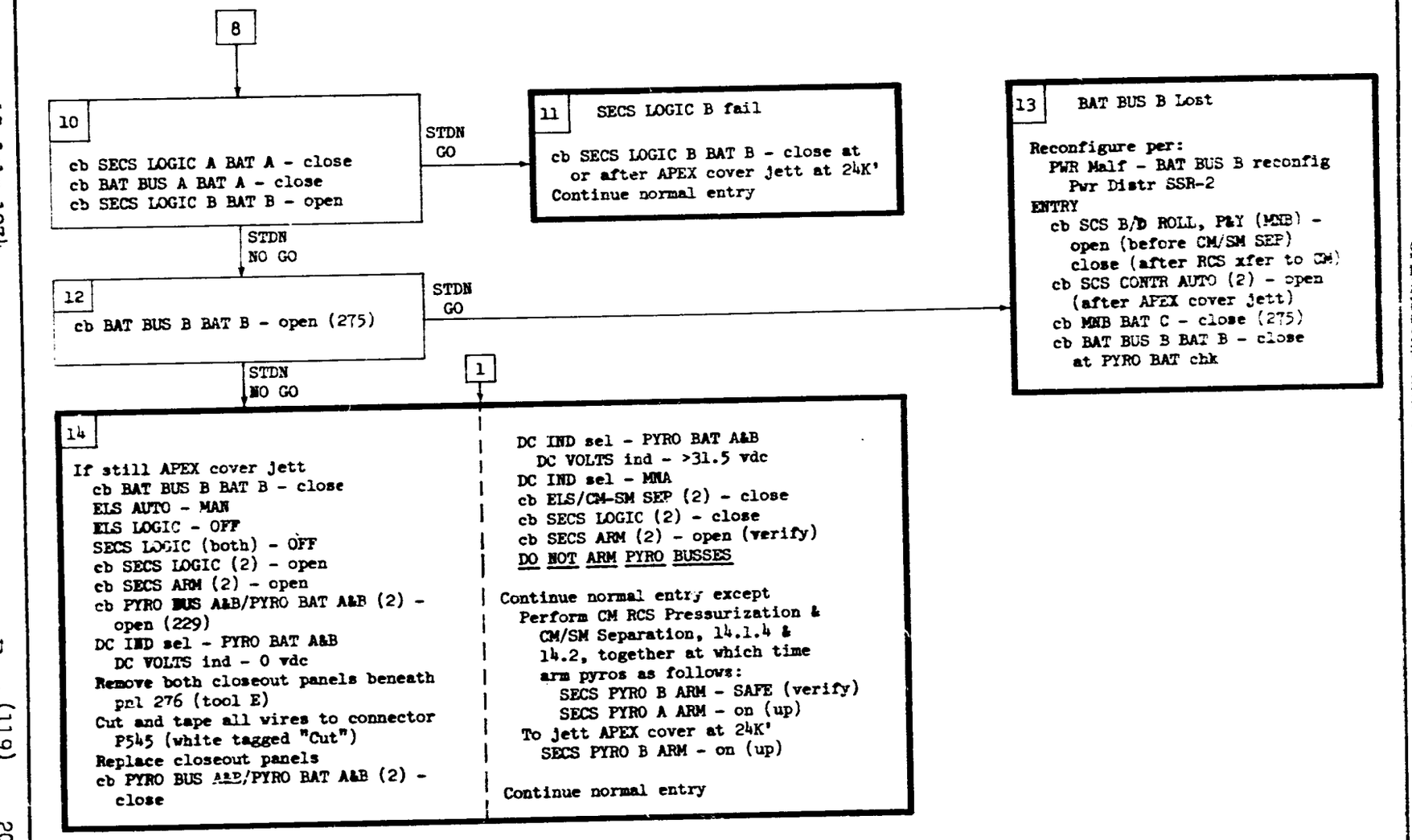
STA/T STEP	PROCEDURE	PANEL	REMARKS

20.2.8 Emergency Safe of Apex Cover Jett



EMERGENCY SAFE OF APEX COVER JETT

STA/T STEP	PROCEDURE	PANEL	REMARKS



20.2.8 EMERGENCY SAFE OF APEX COVER JETT

EMERGENCY

STA/C STEP	PROCEDURE	PANEL	REMARKS
	20.2.9 One Y Strut Will Not Fully Extend and Lock		The other Y strut should be extended and locked as the following operations are performed.
AC	1 Break lockwire on one Y strut adjustment jam nut of affected Y strut		
	2 Using tool F, unscrew jam nut		
	3 Disengage washer key so that strut bearing pad will turn		
	4 Screw strut bearing pad inboard until strut can be extended and locked		
	5 Replace washer key, & tighten jam nut		Lockwire and key are not required for water landing.
	20.2.10 SM RCS Jet Failed On		
	1 Change to other control mode		Either SC CONT (if in G&N or SCS) or THC (if in G&N) used to select other mode (CMC or SCS), not controlling jets.
	2 RHC PWR DIR (both) - MNA/MNB	1	
	RHC - null SC rates using dir RCS		
	AUTO RCS (16) - OFF	8	
	If condition persists		
	AUTO RCS (16) - MNA or MNB (as req)		
	MAN ATT (3) - ACCEL CMD	1	
	Null SC rates		
	cb SCS DIR ULL (2) - open	8	
	RHC PWR DIR (both) - OFF	1	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If condition persists		
CP		SM RCS PRPLNT (affected quad) - CLOSE	2	CLOSE position is momentary.
	20.2.11	CM RCS Fails to Pressurize or Feed Propellant		
	1	Verify elect for pressurization		
		cb EPS BAT BUS (2) - close	229	
DP		cb PYRO BUS A&B/PYRO BAT A&B (2) - close		
AC		cb SECS ARM (2) - close	8	
		SECS PYRO ARM (2) - on (up)		Lever lock.
		SECS LOGIC (both) - on (up)		Lever lock.
CP	2	Cycle CM RCS PRESS - on (up)	2	Guarded.
	3	Verify elect to CM RCS prplnt vlvs		
DP		cb EPS GRP 1 & 3 (4) - close	229	
AC		cb RCS PRPLNT ISOL (2) - close	8	
CP	4	Cycle CM RCS PRPLNT (both) - on (up)	2	
	5	Open He and prplnt crossfeed		
		cb EPS GRP 5 (2) - close	229	
AC		cb RCS LOGIC (2) - close	8	
		CM RCS LOGIC - on (up)	1	
		CM PRPLNT DUMP - on (up) (momentarily) then OFF		Guarded. Once interconnected, systems cannot be isolated.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	20.2.12	FC 1 (2,3) C&W Light On		Fuel cell 1 (2,3) light may be illuminated by the following, less time critical failures: FC SKIN TEMP ind - >475°F or <360°F FC COND EXH TEMP ind - >175°F or <150°F FC pH HI tb - bp (SKIN TEMP & COND EXH TEMP, can be verified by meters on panel 3.)
DP		Check FC REACS tb (all) If FC 1 (2,3) REACS tb - gray	3	
		Perform malfunction procedure Fuel cell symptom 1		Malfunction procedures are in the Flight Data File (FDF).
		If FC 1 (2,3) REACS tb - bp		If barber pole, rapid crew reaction is required to prevent fuel cell loss: <20 seconds after H2 valve closure <90 seconds after O2 valve closure.
		FC 1 (2,3) REACS - on (up)		On (up) position is momentary.
		If FC 1 (2,3) REACS tb still bp & flow ~0		Flow verified on panel 3 meter.
		CAUTION When open circuiting one of three fuel cells ensure remaining fuel cells configured with one on each main bus		
		FC 1 (2,3) MNA & MNB - OFF Perform malfunction procedure Fuel cell symptom 1h		Removes fuel cell from main buses. Malfunction procedures are in the Flight Data File (FDF).

FC 1 (2,3) C&W LIGHT ON

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		20.3 POSTLANDING EMERGENCY PROCEDURES		
		20.3.1 Fire/Smoke in CM During Postlanding		
		a. Stable I		
ALL		Don emer O2 mask (refer to Oper of Emer O2 Masks, 5.4.14)	2	
AC		DIRECT O2 vlv - close (CW) (verify)	7	
CP		cb BAT BUS A&B BAT A&B (2) - open	275	
		cb BAT BUS A&B BAT C (2) - open		
		cb FLT/PL BUS BAT C - open	5	
		cb BAT CHGR BAT C/EDS 2 - open		
		cb PYRO BUS A&B PYRO BAT A&B (2) - open	229	
		Fire extinguisher - use as appropriate		Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels, closed compartments, and electrical fires.
		&/or Egress CM (refer to Stable I Water Egress Procedure, 16.4.2)		
		b. Stable II		
ALL		Don emer O2 mask (refer to Oper of Emer O2 Masks, 5.4.14)		
AC		DIRECT O2 vlv - close (CW) (verify)	7	
CP		Fire extinguisher - use as appropriate		Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels. closed compartments, and electrical fires.
		Upright CM to Stable I (refer to Postlanding Stabilization, Floating Inverted, 16.1) & proceed to step a		
		If CM fails to upright Perform Stable II Water Egress Procedure, 16.4.3		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		21.0 DOCKED EMERGENCY PROCEDURES		
		21.1 CSM/DM DOCKED EMERGENCY PROCEDURES		
		21.1.1 Forward Hatch Cannot Be Re-Installed		
CP ALL	1	Position hatch & depress tunl Don PGA, 5.4.6, thermal gloves, & check suit circuit, 5.4.5		
CP		Verify CAB PRESS ind - 4.7-5.3 psia	2	
		Verify O2 FLOW ind - 0.4-0.6 lb/hr		
		Position fwd hatch against tunl hatch seal interface misaligning the hatch indicator arrows by 30° in either direction		
		While pushing hatch firmly against tunl hatch seal interface		
		TUNL VENT vlv - TUNL VENT	12	
		Wait one min, then place TUNL VENT vlv - DM/CM ΔP		
		Monitor DM/CM ΔP ind and verify ΔP ≈2.5 psid. If ΔP ≠2.5 psid, recycle DM TUNL VENT vlv until ΔP ind is ≈2.5 psid		When DM/CM ΔP indicator indicates ≈2.5 psid, hatch should be held immobile against seal by ΔP.
		Continue monitoring DM/CM ΔP ind for 1 min after reaching ≈2.5 psid & verify no detectable change in ΔP ind		This constitutes a hatch seal integrity check.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		DM/CM ΔP ind - press diff decr Monitor CAB PRESS ind & O2 FLOW ind	2	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If CAB PRESS ind & O2 FLOW ind remain stable, DM hatch is probably not integral	2	
		If CAB PRESS ind decr & O2 FLOW ind incr, CM fwd hatch is probably not integral		
		Press tunl using PRESS EQUAL vlv	Fwd hatch	
		Remove fwd hatch, 5.7.1		
		Check for foreign object(s) jammed in tunl/hatch, seal interface, or hatch seal damage		
		Reposition fwd hatch against hatch seal interface		
		Reinitiate tunl depress & hatch seal integrity check		
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
	2	Perform DM Jettison & Separation, 4.4		
	3	Perform the following ≈TBD prior to CM/SM separation to raise CM press to maximum design press of 8.6 psid		
AC		CAB PRESS RELF vlv (2) - CLOSE	325	
CP		REPRESS PKG vlv - OFF	326	
		EMER CAB PRESS sel - OFF	351	
		CAB REPRESS vlv - OPEN (CW)		
		REPRESS O2 VLV - CLOSE	601	

FORWARD HATCH CANNOT BE RE-INSTALLED

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		When CAB PRESS ind - 8.6 psia	2	
		CAB REPRESS vlv - OFF (CCW)	351	
		REPRESS PKG vlv - FILL	326	
	4	Begin entry prep, 14.1		
60K'		REPRESS 02 VLV - OPEN	601	Guarded. Provides an additional 3 psia in ≈1-minute period.
AC	50K'	Report CM stable		
		CM unstable		
CP		RCS CMD - OFF	2	OFF position is momentary.
AC	40K'	APEX COVER JETT pb - push	1	Guarded.
		DROG DPLY pb - push		Guarded.
		(2 sec after apex cover jett)		
30K'		ELS LOGIC - on (up)		Guarded.
		ELS AUTO - AUTO		
24K'		SCS RCS disable (auto)		
CP		RCS CMD - OFF	2	OFF position is momentary.
		Apex cover jett (auto)		The apex cover will be jettisoned at 24K feet plus 0.4 second.
AC		APEX COVER JETT pb - push	1	Guarded.

FORWARD HATCH CANNOT BE RE-INSTALLED

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Drogue chutes deployed (auto)		Drogue parachutes deployed at 24K feet plus 2.0 seconds. The CM may be very unstable until the drogue chutes disreef in ≈11 seconds.
		xxxxxxxxxxxxxxxxxxxxxxx		
AC		DROG DPLY pb - push	1	Guarded.
		xxxxxxxxxxxxxxxxxxxxxxx		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no drogue deployment. ELS AUTO - MAN Stabilize CM with direct RCS		
	5K'	MN DPLY pb - push ELS AUTO - AUTO		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP				
10K'		CAB PRESS ind - 10 psia	2	Indication of main chute deploy altitude.
		Main chutes & VHF recovery antenna deploy (auto)		Auto deployment occurs between 10,950 and 9,100 feet. Parachutes disreef in ≈15 seconds after pilot mortars fire.
		MN DPLY pb - push		Guarded.
		CAUTION Exercise care in handling fwd hatch as it will be at a high temperature.		

FORWARD HATCH CANNOT BE RE-INSTALLED

STA/T STEP	PROCEDURE	PANEL	REMARKS
+20 sec	Immediately following main parachute disreefing, CP must egress from center couch and position himself in an optimum stance to support the fwd hatch (*85 lbs)		
	When CP in position CAB PRESS DUMP vlv - open (CCW) (full open)	Side hatch	
	As press equalization allows fwd hatch to move, retrieve hatch & stow	Fwd hatch	
	CAB PRESS DUMP vlv - close (CW)	Side hatch	
DP	Set up entry comm VHF ANT - RECY VHF AM A - SIMPLEX VHF BCN - ON	3	If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of transmission.
AC	Transmit voice (VHF AM) reporting Position Main chutes disreefed Splash error Crew status		Continue voice transmission until touchdown.
	Crew couch struts (4) - unlock		
DP	cb FLT/PL BUS BAT A, B, & C (3) - close cb FLT/PL BUS MNA & B (2) - open	5	
AC 3K'	cb SPS PITCH, YAW (4) - open	8	

21.1.1 FORWARD HATCH CANNOT BE RE-INSTALLED

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		FLOOD FIXED - POST LDG	8	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area. Minimize floodlight use during postlanding. Maximum utilization should be 9.6 hours per 48-hour period.
		FLOOD DIM - 1 or 2		Position 1 provides power to two secondary floodlights and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position after dc main buses deactivated.
800'				
CP		CM RCS PRPLNT (both) - OFF	2	OFF position is momentary.
		CM RCS PRPLNT tb (both) - bp		Barber pole indicates at least one propellant isolation valve (fuel or oxidizer) closed in each particular system 1 or 2.
AC		DIRECT O2 vlv - OPEN (CCW)	7	
DP		MN BUS TIE (2) - OFF	5	Removes battery power from dc main buses A and B.
		CAUTION MN BUS TIE switches must be left in the OFF position to ensure bat A, B, & C are used to pwr postlanding bus only, & to prevent bat shorting caused by water entering the CM feed-thru connectors.		
		cb BAT RLY BUS (2) - open Postlanding Check, sec 16		

FORWARD HATCH CANNOT BE RE-INSTALLED

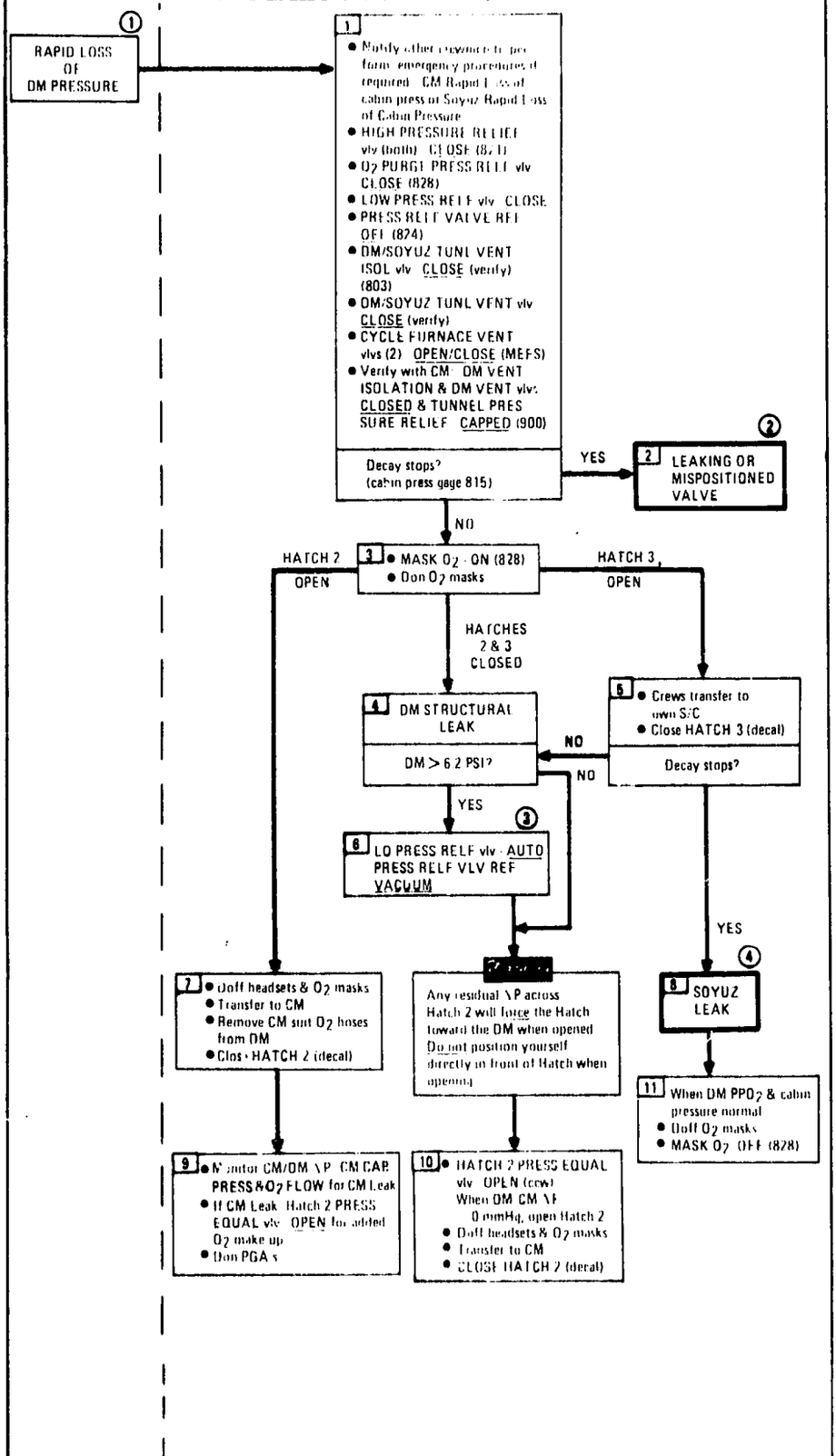
STA/T	STEP	PROCEDURE	PANEL	REMARKS
		21.1.2 Fire/Smoke in CM - Docked Operations		
		TBD		
		21.1.3 Time Critical Undocking & Separation		
		TBD		
		21.1.4 Abnormal Vehicle Dynamics		
		TBD		
		21.2 DM/SOYUZ DOCKED EMERGENCY PROCEDURES		
		21.2.1 Time Critical Undocking & Separation		
	1	If hatch 3 closed, go to 3		Mixed crew returns permissible for time critical situations when crews are isolated in DM with hatch 3 closed.
		or Transfer to DM from SOYUZ		
		S J-BOX		
		AUDIO POWER - OFF	S J-BOX	
		Disconnect CCU		
		Enter DM		
(DM)		AUDIO 2 POWER - ON (verify)	818	
		Remove DM/SOYUZ Ventilation Duct		
		Deactivate DM/SOYUZ Umbilicals		Except for drag through, DM/Soyuz umbilical disconnect not required.
		cb SOYUZ POWER DMB - open	825	
		cb SOYUZ CABLE COMM (2) - open (SOYUZ)	TBD	
		Remove Umbilicals (3) (if time permits)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Close Hatch 3, 18.6.1 (step 3)		
	3	Vent Tun'l 2 & Check Hatch 3 Integrity, 18.3.6, (if time permits)		Tunnel 2 venting not mandatory.
	4	Undocking With Soyuz, CM Active, 18.1.2 Separate to safe distance		Undocking with crew in DM permitted.
	5	Purge/Vent DM to 290 mm Hg		
(DM)		O2 PURGE PRESS RELF vlv - AUTO	828	
		PRESS RELF VLV REF - VACUUM	824	
		O2 PURGE vlv - OPEN (ccw)		
		O2 PART PRESS ind (2) - 300 mm Hg	815	
		O2 PURGE vlv - close (cw)	824	
		PRESS RELF VLV REF - DM		
		O2 PURGE PRESS RELF - CLOSE	828	
		LOW PRESS RELF vlv - AUTO		
		PRESS RELF VLV REF - VACUUM	824	
		CAB PRESS ind - 290 mm Hg	815	
		PRESS RELF VLV REF - DM	824	
		LOW PRESS RELF vlv - CLOSE	828	
	6	Open Hatch 2, 18.6.1 Transfer to CM.		
	21.2.2	Fire, Smoke, Contaminants/DM at Soyuz Pressure		
		TBD		
	21.2.3	Fire, Smoke, Contaminants/DM at CM Pressure		
		TBD		

TIME CRITICAL UNDOCKING & SEPARATION

SYMPTOM	PROCEDURE	REMARKS

21.2.4 Rapid Loss of DM Pressure



(1) HIGH O_2 FLOW Lt will come on at cabin pressure < 238mmHg. PPO_2 Lt may also come on

(2) Perform DM ECS malfunction procedure one vehicle at a time to isolate leak.

(3) Prevents DM high nitrogen content entering CM before opening Hatch 2 PRESS EQUAL vlv

(4) U.S. crew standby Soyuz leak rate and leak repairability will determine if Soyuz crew transfer to DM required

APPENDIX A

CM PANEL ILLUSTRATIONS AND CONTROL/INDICATOR CONFIGURATION LIST FOR CSM 119

This section contains CM panel illustrations and a control/indicator configuration list for CSM 119. Panel illustrations present the location of the displays and controls as they appear on the panels in the CM. The control/indicator configuration list provides the configuration of the CM displays and controls prior to backup crew cabin ingress, at lift-off, docked to Soyuz, and entry preparation. Entry preparation is defined as those functions that are required to be performed to place the vehicle in a posture to perform a deorbit burn. Those talkbacks (tb) are included which reflect the last position selected of spring-loaded switches. (Talkback indicators that are operated by sensors will not be listed.) The CSM control/indicator configuration list presents the panels in numerical sequence. The switches are not to be sequentially positioned as listed.

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 1					
EMS FUNC	OFF	ΔV	OFF	ΔV	
EMS MODE	STBY	STBY	STBY	STBY	
GTA sw	off (down)	off (down)	off (down)	N/A	
EMS GTA COVER	Secure	Secure	N/A	N/A	
CMC ATT	IMU	IMU	IMU	IMU	
FDAI SCALE	5/1	5/5	5/1	5/1	
FDAI SEL	1/2	1/2	1/2	1/2	
FDAI SOURCE	CMC	CMC	CMC	CMC	
ATT SET	GDC	GDC	GDC	GDC	
MAN ATT ROLL	RATE CMD	RATE CMD	RATE CMD	RATE CMD	
MAN ATT PITCH	ACCEL CMD	ACCEL CMD	RATE CMD	RATE CMD	
MAN ATT YAW	RATE CMD	RATE CMD	RATE CMD	RATE CMD	
LIM CYCLE	OFF	OFF	OFF	OFF	
ATT DBD	MIN	MIN	MAX	MIN	
RATE	HI	HI	HI	LO	
THC PWR	OFF	on (up)	OFF	on (up)	
RHC PWR NORM 1	OFF	AC/DC	OFF	AC/DC	
RHC PWR NORM 2	OFF	AC/DC	OFF	AC/DC	
RHC PWR DIR 1	OFF	MNA/MNB	OFF	MNA/MNB	
RHC PWR DIR 2	OFF	MNA/MNB	OFF	MNA/MNB	
SC CONT	SCS	SCS	SCS	CMC	
CMC MODE	FREE	FREE	FREE	FREE	
BMAG MODE ROLL	RATE 2	RATE 1	RATE 1	RATE 2	
BMAG MODE PITCH	RATE 2	RATE 1	RATE 1	RATE 2	
BMAG MODE YAW	RATE 2	RATE 1	RATE 1	RATE 2	
SPS THRUST	NORM (locked)	NORM (locked)	NORM (locked)	NORM (locked)	
ΔV THRUST A	OFF (guarded)	OFF (guarded)	OFF (guarded)	NORM	
ΔV THRUST B	OFF (guarded)	OFF (guarded)	OFF (guarded)	NORM	
SCS TVC PITCH	RATE CMD	AUTO	RATE CMD	RATE CMD	
SCS TVC YAW	RATE CMD	AUTO	RATE CMD	RATE CMD	

GMBL MOT P1	OFF	OFF	OFF	OFF
GMBL MOT P2	OFF	OFF	OFF	OFF
GMBL MOT Y1	OFF	OFF	OFF	OFF
GMBL MOT Y2	OFF	OFF	OFF	OFF
ATVC GAIN	LO	LO	HI	HI
ELS LOGIC	OFF (guarded)	OFF (guarded)	OFF (guarded)	OFF (guarded)
ELS AUTO	MAN	MAN	MAN	MAN
CM RCS LOGIC	OFF	on (up)	OFF	on (up)
CM PRPLNT DUMP	OFF (guarded)	OFF (guarded)	OFF (guarded)	OFF (guarded)
CM PRPLNT PURG	off (guarded)	off (guarded)	off (guarded)	off (guarded)
IMU CAGE	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)
EMS ROLL	OFF	OFF	OFF	OFF
.05 G sw	OFF	OFF	OFF	OFF
Pc IND sw	Pc	Pc	Pc	Pc
LV IND/GPI sw	SIVB	SIVB	GPI	GPI
TVC GMBL DR PITCH	AUTO	AUTO	AUTO	AUTO
TVC GMBL DR YAW	AUTO	AUTO	AUTO	AUTO
EVNT TMR RSET	up (ctr)	up (ctr)	up (ctr)	up (ctr)
EVNT TMR START	ctr	ctr	ctr	ctr
EVNT TMR MIN	ctr	ctr	ctr	ctr
EVNT TMR SEC	ctr	ctr	ctr	ctr
PANEL 2				
PL VENT VLV	push (lock)	push (lock)	push (lock)	push (lock)
PROBE EXTD/REL	OFF (guarded)	OFF (guarded)	OFF (guarded)	off (guarded)
PROBE EXTD/REL A tb	gray	gray	gray	gray
PROBE EXTD/REL B tb	gray	gray	gray	gray
PROBE RETR PRIM	OFF	OFF	OFF	OFF
PROBE RETR SEC	OFF	OFF	OFF	OFF
GUIDE RING A	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)
GUIDE RING B	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)
STRUCT LATCH A	off (Ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (CLOSE*)** (guarded)	off (ctr) (OPEN*) (guarded)

*Identifies last momentary position switched to.
** (OPEN*) When docking performed with CSM passive

PANELS 1 AND 2

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 2 (CONT)					
STRUCT LATCH B	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	
CAPTURE LATCH A	off (down)	off (down)	off (down)	off (down)	
CAPTURE LATCH B	off (down)	off (down)	off (down)	off (down)	
BACKUP PASSIVE A	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	
BACKUP PASSIVE B	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	
RCS IND sel	PSM	SMD	SMD	SMD	
UP TLM CM	BLOCK	BLOCK	BLOCK	BLOCK	
CM RCS PRESS	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
SM RCS IND sw	He TK TEMP	He TK TEMP	He TK TEMP	He TK TEMP	
SM RCS QUAD A He	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)	
SM RCS QUAD A He tb	bp	gray	gray	gray	
SM RCS QUAD B He	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)	
SM RCS QUAD B He tb	bp	gray	gray	gray	
SM RCS QUAD C He	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)	
SM RCS QUAD C He tb	bp	gray	gray	gray	
SM RCS QUAD D He	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)	
SM RCS QUAD D He tb	bp	gray	gray	gray	
SM RCS A PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	
SM RCS A PSM PRPLNT tb	bp	bp	bp	bp	
SM RCS B PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	
SM RCS B PSM PRPLNT tb	bp	bp	bp	bp	
SM RCS C PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	
SM RCS C PSM PRPLNT tb	bp	bp	bp	bp	

SM RCS D PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)
SM RCS D PSM PRPLNT tb	bp	bp	bp	bp
SM RCS QUAD A PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)
SM RCS QUAD A PRIM PRPLNT tb	bp	gray	gray	gray
SM RCS QUAD A SEC PRPLNT tb	bp	gray	gray	gray
SM RCS QUAD B PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)
SM RCS QUAD B PRIM PRPLNT tb	bp	gray	gray	gray
SM RCS QUAD B SEC PRPLNT tb	bp	gray	gray	gray
SM RCS QUAD C PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)
SM RCS QUAD C PRIM PRPLNT tb	bp	gray	gray	gray
SM RCS QUAD C SEC PRPLNT tb	bp	gray	gray	gray
SM RCS QUAD D PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)
SM RCS QUAD D PRIM PRPLNT tb	bp	gray	gray	gray
SM RCS QUAD D SEC PRPLNT tb	bp	gray	gray	gray
RCS CMD	ctr (OFF*)	ctr (OFF*)	ctr (OFF*)	ctr (OFF*)
RCS TRNFR	ctr (SM*)	ctr (SM*)	ctr (SM*)	ctr (SM*)
CM RCS 1 PRPLNT	ctr (OFF*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
CM RCS 1 PRPLNT tb	bp	gray	gray	gray
CM RCS 2 PRPLNT	ctr (OFF*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
CM RCS 2 PRPLNT tb	bp	gray	gray	gray
RCS A SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
RCS B SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
RCS C SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
RCS D SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
EDS AUTO	OFF	on (up)	OFF	OFF
DOCK RING SEP 1	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)
DOCK RING SEP 2	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)
CM/SM SEP 1	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)
CM/SM SEP 2	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)
SIVB/DM SEP	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)

*Identifies last momentary position switched to.

PANEL 2

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
	PANEL 2 (CONT)				
PRPLNT DUMP	AUTO	AUTO	RCS CMD	RCS CMD	
2 ENG OUT sw	AUTO	AUTO	OFF	OFF	
LV RATES sw	AUTO	AUTO	OFF	OFF	
TWR JETT 1	AUTO (guarded)	AUTO (guarded)	OFF (ctr) (guarded)	OFF (ctr) (guarded)	
TWR JETT 2	AUTO (guarded)	AUTO (guarded)	OFF (ctr) (guarded)	OFF (ctr) (guarded)	
LV GUID sw	IU	IU	IU	IU	
MAIN REL	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
MSN TMR HRS	ctr	ctr	ctr	ctr	
MSN TMR MIN	ctr	ctr	ctr	ctr	
MSN TMR SEC	ctr	ctr	ctr	ctr	
C/W NORM	NORM	BOOST	ACK	NORM	
C/W CSM	CSM	CSM	CSM	CSM	
C/W PWR	1	1	1	1	
C/W LAMP TEST	ctr	ctr	ctr	ctr	
C/W MEMORY	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	
MSN TMR	STOP	START	START	START	
RCS IND sel	CM 2	SM D	SM D	as desired	
CAB FAN 1	OFF	OFF	OFF	OFF	
CAB FAN 2	OFF	OFF	OFF	OFF	
H2 HTRS 1	AUTO	AUTO	AUTO	off (ctr)	
H2 HTRS 2	AUTO	AUTO	AUTO	off (ctr)	
O2 PRESS IND sw	1	SRG	SRG	SRG	
O2 HTRS 1	AUTO	AUTO	AUTO	off (ctr)	
O2 HTRS 2	AUTO	AUTO	AUTO	off (ctr)	
H2 FANS 1	AUTO	AUTO	AUTO	off (ctr)	
H2 FANS 2	AUTO	AUTO	AUTO	off (ctr)	

ECS IND sel	PRIM	PRIM	PRIM	PRIM	
RAD FLOW CONT AUTO	AUTO	AUTO	AUTO	AUTO	
ECS RAD tb	gray	gray	gray	gray	
RAD FLOW CONT PWR	off (ctr)	off (ctr)	PWR	PWR	
RAD MAN SEL	RAD 1	RAD 1	RAD 1	RAD 1	
RAD PRIM HTR	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
RAD SEC HTR	OFF	OFF	OFF	OFF	
POT H2O HTR	OFF	OFF	ON	OFF	
SUIT H2O ACCUM AUTO	ctr	1	1	1	
SUIT H2O ACCUM ON	ctr	ctr	ctr	ctr	
SEC COOL EVAP	off (ctr)	off (ctr)	off (ctr) (EVAP*)	off (ctr) (EVAP*)	
SEC COOL PUMP	AC2	AC2	off (ctr)	off (ctr)	
SEC EVAP H2O FLOW	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
GLY EVAP IN TEMP	MAN	MAN	AUTO	AUTO	
GLY EVAP STM AUTO	MAN	MAN	AUTO	AUTO	
GLY EVAP STM INCR	ctr	ctr (vlv partially open)	ctr	ctr	
GLY EVAP H2O FLOW	off (ctr)	off (ctr)	AUTO	AUTO	
H2O QTY IND sw	POT	POT	WASTE	WASTE	
SM H2O TANK	CLOSE	CLOSE	CLOSE	CLOSE	
SM RCS PSM He	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	ctr (CLOSE*)	
SM RCS PSM He tb	bp	bp	bp	bp	
SM RCS PSM MANF ISOL	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)	
SM RCS PSM MANF ISOL tb	bp	gray	gray	gray	
PANEL 3					
VHF ANT	SM LEFT	SM LEFT	as req	SM LEFT	
SPS INJ VLV A1 ind	CLOSE	CLOSE	CLOSE	CLOSE	
SPS INJ VLV A2 ind	CLOSE	CLOSE	CLOSE	CLOSE	
SPS INJ VLV B3 ind	CLOSE	CLOSE	CLOSE	CLOSE	

PANELS 2 THRU 3

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 3					
SPS INJ VLV B4 ind	CLOSE	CLOSE	CLOSE	CLOSE	
FC 1 RAD	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	
FC 1 RAD tb	gray	gray	gray	gray	
FC 2 RAD	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	
FC 2 RAD tb	gray	gray	gray	gray	
FC 3 RAD	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	
FC 3 RAD tb	gray	gray	gray	gray	
FC 1 HTRS	on (up)	on (up)	on (up)	on (up)	
FC 2 HTRS	on (up)	on (up)	on (up)	on (up)	
FC 3 HTRS	on (up)	on (up)	on (up)	on (up)	
FC IND sel	1	1	1	1	
SPS QTY TEST	ctr	ctr	ctr	ctr	
OXID FLOW VLV INCR	NORM	NORM	NORM	NORM	
OXID FLOW VLV PRIM	PRIM	PRIM	PRIM	PRIM	
PUG MODE	NORM	NORM	NORM	NORM	
FC 1 PURG	OFF	OFF	OFF	OFF	
FC 2 PURG	OFF	OFF	OFF	OFF	
FC 3 PURG	OFF	OFF	OFF	OFF	
SM PWR SOURCE 1 MNA	OFF	ctr (on,up*)	ctr (on,up*)	ctr (on, up*)	
SM PWR SOURCE 1 MNA tb	bp	gray	gray	gray	
SM PWR SOURCE 2 MNA	ctr (on,up*)	ctr (on,up*)	ctr (on,up*)	ctr (on,up)	
SM PWR SOURCE 2 MNA tb	gray	gray	gray	gray	
SM PWR SOURCE 3 MNA	OFF	OFF	OFF	OFF	
SM PWR SOURCE 3 MNA tb	bp	bp	bp	bp	
MNA RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	
SPS He VLV 1	AUTO	AUTO	AUTO	AUTO	
SPS He VLV 1 tb	bp	bp	bp	bp	

SPS He VLV 2	AUTO	AUTO	AUTO	AUTO
SPS He VLV 2 tb	bp	bp	bp	bp
SPS TEMP IND sw	OXID LN	OXID LN	as desired	as desired
SPS PRESS IND sw	He	He	as desired	as desired
FC 1 REACS	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)	ctr on, up*)
FC 1 REACS tb	gray	gray	gray	gray
FC 2 REACS	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
FC 2 REACS tb	gray	gray	gray	gray
FC 3 REACS	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
FC 3 REACS tb	gray	gray	gray	gray
SM PWR SOURCE 1 MNB	OFF	OFF	OFF	OFF
SM PWR SOURCE 1 MNB tb	bp	bp	bp	bp
SM PWR SOURCE 2 MNB	OFF	OFF	OFF	OFF
SM PWR SOURCE 2 MNB tb	bp	bp	bp	bp
SM PWR SOURCE 3 MNB	OFF	bp	ctr (on, up*)	ctr (on, up*)
SM PWR SOURCE 3 MNB tb	bp	gray	gray	gray
MNB RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)
DC IND sel	MNA	MNA	MNA	MNA
BAT CHG	OFF	OFF	OFF	OFF
S BD XPNDR	OFF	PRIM	PRIM	PRIM
S BD PWR AMPL PRIM	PRIM	PRIM	PRIM	PRIM
S BD PWR AMPL HI	off (ctr)	HI	LO	HI
PWR AMPL tb	bp	gray	gray	gray
S BD MODE VOICE	VOICE	VOICE	VOICE	VOICE
S BD MODE PCM	PCM	PCM	PCM	PCM
S BD MODE RNG	RNG	RNG	RNG	RNG
S BD AUX TAPE	ctr	ctr	ctr	ctr
S BD AUX TV	ctr	ctr	ctr	ctr
UP TLM DATA	DATA	DATA	DATA	DATA
UP TLM CMD	OFF	NORM	NORM	NORM
S BD ANT OMNI A	B	B	as req	as req
S BD ANT OMNI	OMNI	OMNI	as req	as req

* Identifies last momentary position switched to.

PANEL 3

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
	PANEL 3 (CONT)				
VHF AM SQLCH A tw	noise +1	noise +1	noise +1	noise +1	
VHF AM A	off (ctr)	off (ctr)	off (ctr)	SIMPLEX	
VHF AM B	off (ctr)	DUPLEX	off (ctr)	off (ctr)	
VHF AM RCV	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
VHF BCN	OFF	OFF	OFF	OFF	
VHF RNG	OFF	OFF	OFF	OFF	
S BD SQLCH	ENBL	ENBL	ENBL	ENBL	
FC REAC VLVS	NORM	LATCH	NORM	NORM	
H2 PURG LINE HTR	OFF	OFF	OFF	OFF	
VHF AM SQLCH B tw	noise +1	noise +1	noise +1	noise +1	
TAPE RCDR PCM	PCM/ANLG	PCM/ANLG	PCM/ANLG	PCM/ANLG	
TAPE RCDR RCD	RCD	RCD	RCD	RCD	
TAPE RCDR FWD	off (ctr)	FWD	FWD	FWD	
TAPE MOTION tb	bp	gray	(STDN command)	gray	
SCE PWR	NORM	NORM	NORM	NORM	
PMP PWR	NORM	NORM	NORM	NORM	
PCM BIT RATE	HI	HI	LO	LO	
PTT BU	NORM	NORM	NORM	NORM	
INV 1	MNA	MNA	MNA	MNA	
INV 2	MNB	MNB	MNB	MNB	
INV 3	OFF	OFF	OFF	OFF	
INV 1 AC1	on (up)	on (up)	on (up)	on (up)	
INV 2 AC1	OFF	OFF	OFF	OFF	
INV 3 AC1	OFF	OFF	OFF	OFF	
AC1 RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	
INV 1 AC2	OFF	OFF	OFF	OFF	
INV 2 AC2	on (up)	on (up)	on (up)	on (up)	
INV 3 AC2	OFF	OFF	OFF	OFF	
AC2 RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	
AC IND sel	BUS 2 ØC	BUS 2 ØC	BUS 2 ØC	BUS 2 ØC	

PANEL 4					
SPS GAUGING	OFF	OFF	OFF	OFF	
TELCOM GRP 1	AC1	AC1	AC1	AC1	
TELCOM GRP 2	AC2	AC2	AC2	AC2	
GLY PUMPS	2 AC1	1 AC1	1 AC1	1 AC1	
SUIT COMPR 1	OFF	AC1	AC1	AC1	
SUIT COMPR 2	OFF	OFF	OFF	OFF	
cb SUIT COMPR AC1 ØA	close	close	close	close	
cb SUIT COMPR AC1 ØB	close	close	close	close	
cb SUIT COMPR AC1 ØC	close	close	close	close	
cb SUIT COMPR AC2 ØA	close	close	close	close	
cb SUIT COMPR AC2 ØB	close	close	close	close	
cb SUIT COMPR AC2 ØC	close	close	close	close	
cb GLY PUMPS AC1 ØA	close	close	close	close	
cb GLY PUMPS AC1 ØB	close	close	close	close	
cb GLY PUMPS AC1 ØC	close	close	close	close	
cb GLY PUMPS AC2 ØA	close	close	close	close	
cb GLY PUMPS AC2 ØB	close	close	close	close	
cb GLY PUMPS AC2 ØC	close	close	close	close	
PANEL 5					
MN BUS TIE BAT A/C	OFF	on (up)	OFF	on (up)	
MN BUS TIE BAT A/C	OFF	on (up)	OFF	on (up)	
FC1 PUMPS	AC1	AC1	AC1	AC1	
FC2 PUMPS	AC2	AC2	AC2	AC2	
FC3 PUMPS	AC2	AC2	AC2	AC2	
SM RCS A ENG PKG HTRS	OFF	OFF	1	1	
SM RCS C ENG PKG HTRS	OFF	OFF	1	1	
SM RCS B ENG PKG HTRS	OFF	OFF	1	1	
SM RCS D ENG PKG HTRS	OFF	OFF	1	1	
SM RCS A QUAD HTRS	OFF	OFF	PRIM	PRIM	
SM RCS C QUAD HTRS	OFF	OFF	PRIM	PRIM	
SM RCS B QUAD HTRS	OFF	OFF	PRIM	PRIM	
SM RCS D QUAD HTRS	OFF	OFF	PRIM	PRIM	
SM RCS PSM 1 HTRS	OFF	OFF	PRIM	PRIM	
SPS HTRS	OFF	OFF	PRIM	PRIM	

PANELS 3 THRU 5

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 5 (CONT)					
cb FLT/PL BUS MNA	close	close	close	close	
cb FLT/PL BUS MNB	close	close	close	close	
cb FLT/PL BUS BAT A	open	open	open	open	
cb FLT/PL BUS BAT B	open	open	open	open	
cb FLT/PL BUS BAT C	open	open	open	open	
cb EPS SNSR SIG AC1	close	close	close	close	
cb EPS SNSR SIG AC2	close	close	close	close	
cb EPS SNSR SIG MNA	close	close	close	close	
cb EPS SNSR SIG MNB	close	close	close	close	
cb EPS SNSR PWR 1 BAT RLY	close	close	close	close	
cb EPS SNSR PWR 2 BAT RLY	close	close	close	close	
cb BAT RLY BUS BAT A	close	close	close	close	
cb BAT RLY BUS BAT B	close	close	close	close	
INTGL LTS	on (cw)	as desired	as desired	as desired	
FLOOD LTS	OFF (full dim or full brt)	OFF (full dim or full brt)	OFF (full dim or full brt)	OFF (full dim or full brt)	
FLOOD DIM	1	1	1	1	
FLOOD FIXED	OFF	OFF	OFF	OFF	
BAT CHGR	AC1	AC1	AC1	AC1	
cb BAT CHGR AC	close	close	close	close	
cb BAT CHGR MNA	close	close	close	close	
cb BAT CHGR MNB	close	close	close	close	
cb BAT CHGR BAT A	close	close	close	close	
cb BAT CHGR BAT B	close	close	close	close	
cb BAT CHGR BAT C/EDS 2	close	close	close	close	
cb INV CONT 1 BAT RLY	close	close	close	close	
cb INV CONT 2 BAT RLY	close	close	close	close	
cb INV CONT 3 BAT RLY	close	close	close	close	
cb UTIL R/L STA MNA	close	close	close	close	
cb SEC COOL AC1	close	close	close	close	

PANEL 5

cb SEC COOL AC2	close	close	close	close	close
cb SEC COOL HTR CONTR MNA	open	close	close	close	close
cb CAB FANS ØA AC1	close	close	close	close	close
cb CAB FANS ØB AC1	close	close	close	close	close
cb CAB FANS ØC AC1	close	close	close	close	close
cb H2O/URINE DUMP HTR MNA	open	open	open	open	open
cb H2O/URINE DUMP HTR MNB	open	open	open	open	open
cb H2O ACCUM MNA	close	close	close	close	close
cb H2C ACCUM MNB	close	close	close	close	close
cb PRIM RAD CONTR AC1	close	close	close	close	close
cb PRIM RAD CONTR AC2	close	close	close	close	close
cb PRIM RAD CONTR MNA	close	close	close	close	close
cb RPIM RAD CONTR MNB	close	close	close	close	close
cb C/W MNA	close	close	close	close	close
cb C/W MNB	close	close	close	close	close
cb TMRS MNA	close	close	close	close	close
cb TMRS MNB	close	close	close	close	close
cb G/N LTS AC1	close	close	close	close	close
cb G/N LTS AC2	close	close	close	close	close
cb G/N IMU MNA	close	close	close	close	close
cb G/N IMU MNB	close	close	close	close	close
cb G/N IMU HTR MNA	close	close	close	close	close
co G/N IMU HTR MNB	close	close	close	close	close
cb G/N CMPTR MNA	close	close	close	close	close
cb G/N CMPTR MNB	close	close	close	close	close
cb G/N OPT MNA	close	close	close	close	close
cb G/N OPT MNB	close	close	close	close	close
cb INST MNA	close	close	close	close	close
cb INST MNB	close	close	close	close	close
cb EXP BUS MNA	close	close	close	close	close
cb EXP BUS MNB	close	close	close	close	close
cb EXP PWR A EXP BUS	open	open	open	open	open
cb EXP PWR B EXP BUS	open	open	open	open	open
cb EXP PWR C EXP BUS	open	open	open	open	open
cb SPS HTRS MNA	close	close	close	close	close
cb SPS HTRS MNB	close	close	close	close	close
cb UTIL LEB MNB	open	open	open	open	open

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 5 (CONT)					
cb IVA PWR MNB	open	open	open	open	
cb IVA PWR MNA	open	open	open	open	
cb O2 VAC ION PUMPS MNA	close	open	open	open	
cb O2 VAC ION PUMPS MNB	close	open	open	open	
PANEL 6					
MODE	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	
VOX SENS tw	5	as req	as req	as req	
PWR	OFF	AUDIO/TONE	AUDIO	AUDIO/TONE	
MASTER VOL tw	5	as req	5	as req	
VHF FM/PAD COMM	T/R	OFF	OFF	OFF	
VHF FM/PAD COMM VOL tw	5	as desired	as desired	as desired	
CM/RMTE INTERCOM	OFF	OFF	RMTE	OFF	
CM/RMTE INTERCOM VOL tw	decr	decr	incr	decr	
S BD	T/R	T/R	T/R	T/R	
S BD VOL tw	5	as req	5.3	as req	
VHF AM	T/R	T/R	OFF	TT/R	
VHF AM VOL tw	5	as req	5	as req	
AUDIO CONT	NORM	NORM	NORM	NORM	
SUIT PWR	OFF	on (up)	OFF	on (up)	
PANEL 7					
EDS PWR	OFF	on (up)	OFF	OFF	
TVC SERVO PWR 1	OFF	AC1/MNA	AC1/MNA	AC1/MNA	
TVC SERVO PWR 2	OFF	AC2/MNB	AC2/MNB	AC2/MNB	
FDAI/GPI PWR	OFF	BOTH	BOTH	BOTH	
LOGIC 2/3 PWR	on (up)	on (up)	on (up)	on (up)	
ELEC PWR	OFF	GDC/ECA	GDC/ECA	GDC/ECA	

SIG CONDR/DR BIAS PWR 1	OFF	AC1	AC1	AC1	
SIG CONDR/DR BIAS PWR 2	OFF	AC2	AC2	AC2	
BMAG 1 PWR	WAI · UP	ON	ON	ON	
BMAG 2 PWR	WARM UP	ON	ON	ON	
DIRECT 02 vlv	partially OPEN (ccw)	partially OPEN (ccw)	close (cw)	close (cw)	
PANEL 8					
cb SCS TVC AC1	close	close	close	close	
cb SCS AC1	close	close	close	close	
cb SCS AC2	close	close	close	close	
AUTO RCS A/C ROLL A1	OFF	OFF	OFF	OFF	
AUTO RCS A/C ROLL C1	OFF	OFF	OFF	OFF	
AUTO RCS A/C ROLL A2	OFF	OFF	OFF	OFF	
AUTO RCS A/C ROLL C2	OFF	OFF	OFF	OFF	
AUTO RCS B/D ROLL B1	OFF	MNA	MNA	MNA	
AUTO RCS B/D ROLL D1	OFF	MNB	MNB	MNB	
AUTO RCS B/D ROLL B2	OFF	MNA	MNA	MNA	
AUTO RCS B/D ROLL D2	OFF	MNB	MNB	MNB	
AUTO RCS PITCH A3	OFF	MNB	OFF	MNB	
AUTO RCS PITCH C3	OFF	MNA	MNB	MNA	
AUTO RCS PITCH A4	OFF	MNA	MNA	MNA	
AUTO RCS PITCH C4	OFF	MNB	OFF	MNB	
AUTO RCS YAW B3	OFF	MNA	OFF	MNA	
AUTO RCS YAW D3	OFF	MNB	MNB	MNB	
AUTO RCS YAW B4	OFF	MNB	MNA	MNB	
AUTO RCS YAW D4	OFF	MNA	OFF	MNA	
cb SCS ECA/TVC AC2	close	close	close	close	
cb SCS DIR ULL MNA	close	close	open	open	
cb SCS DIR ULL MNB	close	close	open	open	
cb SCS CONTR DIR 1 MNA	close	close	close	close	
cb SCS CONTR DIR 1 MNB	close	close	close	close	
cb SCS CONTR DIR 2 MNA	close	close	close	close	
cb SCS CONTR DIR 2 MNB	close	close	close	close	
cb SCS A/C ROLL MNA	close	close	close	close	
cb SCS A/C ROLL MNB	close	close	close	close	
cb SCS B/D ROLL MNA	close	close	close	close	

PANELS 5 THRU 8

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 8 (CONT)					
cb SCS B/D ROLL MNB	close	close	close	close	
cb SCS PITCH MNA	close	close	close	close	
cb SCS PITCH MNB	close	close	close	close	
cb SCS YAW MNA	close	close	open	close	
cb SCS YAW MNB	close	close	close	close	
NUMERICS LTS	as desired	as desired	as desired	as desired	
FLOOD LTS	OFF (full dim or full BRT)	OFF (full dim or full BRT)	OFF (full dim or full BRT)	OFF (full dim or full BRT)	
INTGL LTS	as desired	as desired	as desired	as desired	
cb ORDEAL AC2	close	close	close	close	
cb ORDEAL MNB	close	close	close	close	
cb SCS CONTR AUTO MNA	close	close	close	close	
cb SCS CONTR AUTO MNB	close	close	close	close	
cb SCS LOGIC 1/2 MNA	close	close	open	close	
cb SCS LOGIC 3/4 MNA	close	close	close	close	
cb SCS LOGIC 1/4 MNB	close	close	open	close	
cb SCS LOGIC 2/3 MNB	close	close	close	close	
cb SCS SYS MNA	close	close	close	close	
cb SCS SYS MNB	close	close	close	close	
FLOOD DIM	1	1	1	1	
FLOOD FIXED	OFF	OFF	OFF	OFF	
FLOAT BAG 1 L	VENT (locked)	VENT (locked)	VENT (locked)	VENT (locked)	
FLOAT BAG 2 R	VENT (locked)	VENT (locked)	VENT (locked)	VENT (locked)	
FLOAT BAG 3 CTR	VENT (locked)	VENT (locked)	VENT (locked)	VENT (locked)	
SECS LOGIC 1	OFF (locked)	on (up) (locked)	OFF (locked)	OFF (locked)	
SECS LOGIC 2	OFF (locked)	on (up) (locked)	OFF (locked)	OFF (locked)	
SECS PYRO A APM	SAFE (locked)	on (up) (locked)	SAFE (locked)	SAFE (locked)	

SECS PYRO B ARM	SAFE (locked)	on (up) (locked)	SAFE (locked)	SAFE (locked)
cb CM RCS 1 HTR MNA	open	open	open	open
cb CM RCS 2 HTR MNB	open	open	open	open
cb SM RCS PRIM A/C HTRS MNB	close	close	close	close
cb SM RCS PRIM B/D HTRS MNA	close	close	close	close
cb SM RCS SEC A/C HTRS MNA	close	close	close	close
cb SM RCS SEC B/D HTRS MNB	close	close	close	close
cb RCS PRPLNT ISOL MNA	close	close	close	close
cb RCS PRPLNT ISOL MNB	close	close	close	close
cb RCS LOGIC MNA	close	close	open	open
cb RCS LOGIC MNB	close	close	open	open
cb EMS MNA	close	close	close	close
cb EMS MNB	close	close	close	close
cb DOCK PROBE MNA	open	open	open	open
cb DOCK PROBE MNB	open	open	open	open
cb SPS GAUGING MNA	open	open	open	open
cb SPS GAUGING MNB	open	open	open	open
cb SPS GAUGING AC1	open	open	open	open
cb SPS GAUGING AC2	open	open	open	open
cb SPS He VLV MNA	close	close	close	close
cb SPS He VLV MNB	close	close	close	close
cb SPS PITCH 1 BAT A	open	close	close	close
cb SPS PITCH 2 BAT 3	close	close	close	close
cb SPS YAW 1 BAT A	open	close	close	close
cb SPS YAW 2 BAT B	close	close	close	close
cb SPS PILOT VLVS A MNA	close	close	close	close
cb SPS PILOT VLVS B MNB	close	close	close	close
cb FLOAT BAG 1 BAT A	open	open	open	open
cb FLOAT BAG 2 BAT B	open	open	open	open
cb FLOAT BAG 3 FLT/PL	open	open	open	open
cb SECS LOGIC A BAT A	open	close	close	close
cb SECS LOGIC B BAT B	open	close	close	close
cb SECS ARM A BAT A	open	close	open	open
cb SECS ARM B BAT B	open	close	open	open
cb EDS 1 BAT A	close	close	open	open
cb EDS 2 BAT C	close	close	open	open

PANEL 8

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 8 (CONT)					
cb EDS 3 BAT B	close	close	open	open	
cb ELS/CM SM SEP BAT A	close	close	open	open	
cb ELS/CM SM SEP BAT B	close	close	open	open	
cb PL VENT FLT/PL	close	close	open	open	
PANEL 9					
MODE	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	
VOX SENS tw	5	as req	as req	as req	
PWR	OFF	AUDIO/TONE	AUDIO	AUDIO/TONE	
MASTER VOL tw	5	as req	5.0	as req	
INTERCOM	T/R	T/R	OFF	T/R	
INTERCOM VOL tw	5	as req	4.2	as req	
VHF FM/PAD COMM	T/R	OFF	OFF	OFF	
VHF FM/PAD COMM VOL tw	5	as desired	as desired	as desired	
S BD	T/R	T/R	OFF	OFF	
S BD VOL tw	5	as req	4.4	as req	
VHF AM	T/R	T/R	OFF	T/R	
VHF AM VOL tw	5	as req	5.4	as req	
AUDIO CONT	NORM	NORM	NORM	NORM	
SUIT PWR	OFF	on (up)	OFF	on (up)	
VHF RNG	NORM	NORM	NORM	NORM	

PANEL 10					
MODE	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	
VOX SENS tw	5	as req	as req	as req	
PWR	OFF	AUDIO/TONE	AUDIO/TONE	AUDIO/TONE	
MASTER VOL tw	5	as req	as desired	as req	
VHF FM/PAD COMM	T/R	OFF	OFF	OFF	
VHF FM/PAD COMM VOL tw	5	as desired	as desired	as desired	
INTERCOM	T/R	T/R	T/R	T/R	
INTERCOM VOL tw	5	as req	as desired	as req	
S BD	T/R	T/R	T/R	T/R	
S BD VOL tw	5	as req	as desired	as req	
VHF AM	T/R	T/R	OFF	T/R	
VHF AM VOL tw	5	as req	as desired	as req	
AUDIO CONT	NORM	NORM	NORM	NORM	
SUIT PWR	OFF	on (up)	OFF	on (up)	
PANEL 12					
TUNL VENT vlv	OFF	DM/CM ΔP	DM/CM ΔP	OFF	
PANEL 13					
FDAI 1	INRTL	INRTL	INRTL	INRTL	
FDAI 2	INRTL	INRTL	INRTL	INRTL	
EARTH/LUNAR	PWR OFF	PWR OFF	PWR OFF	EARTH	
ALT SET cont	88 NM	88 NM	121 NM	121 NM	
LIGHTING	OFF	OFF	OFF	OFF	
MODE	HOLD/FAST	HOLD/FAST	HOLD/FAST	HOLD/FAST	
SLEW	ctr	ctr	ctr	ctr	
PANEL 15					
COAS PWR	OFF	OFF	OFF	OFF	
UTIL PWR	OFF	OFF	OFF	OFF	
PL BCN LT	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
DYE MARKER	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
PL VENT	OFF	OFF	OFF	OFF	

PANELS 8 THRU 15

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION			
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION
PANEL 16				
S5 UTIL PWR	off (down) OFF	off (down) OFF	off (down) OFF	off (down) OFF
PANEL 98				
XMIT/ICOM POWER VOL tw SPEAKER/HEADSET	off (ctr) OFF as req as req	off (ctr) OFF as req HEADSET	off (ctr) ON as req SPEAKER	off (ctr) OFF as req HEADSET
PANEL 100				
UTIL PWR	OFF	OFF	OFF	OFF
FLOOD DIM	1	1	1	1
FLOOD FIXED	OFF	OFF	OFF	OFF
G/N OPT PWR	OFF	OFF	OFF	ON (up)
G/N IMU PWR	on (up) (guarded)	on (up) (guarded)	OFF	on (up) (guarded)
G/N LTS	ACL	ACL	ACL	ACL
NUMERICS LTS	as desired	as desired	as desired	as desired
FLOOD LTS	OFF (full dim or full BRT)	OFF (full dim or full BRT)	OFF (full dim or full BRT)	ON
INTGL LTS	as desired	as desired	as desired	as desired

PANEL 101					
SYS TEST (LH) SYS TEST (RH) CM RCS HTRS WASTE H2O DUMP URINE DUMP	3 B OFF OFF OFF	3 B OFF HTR A HTR A	3 B OFF HTR A HTR A	3 B OFF OFF OFF	
PANEL 122					
OPT ZERO OPT TELTRUN OPT COUPLING OPT MODE OPT SPEED COND LAMPS UP TLM	ZERO SLAVE TO SXT DIR MAN LO ON ACPT	ZERO SLAVE TO SXT DIR MAN LO ON ACPT	ZERO SLAVE TO SXT DIR MAN LO ON ACPT	ZERO SLAVE TO SXT RSLV CMC LO ON ACPT	
PANEL 163					
GLY EVAP	NORM	NORM	NORM	NORM	
PANEL 164					
S1 (Located behind closeout panel and will be set at panel closeout)	OFF	ON	ON	ON	
PANEL 165					
EPE COOLING vlv	COOL	COOL	COOL	COOL	

PANELS 16 THRU 165

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 201					
C/W INPUT 1A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 1B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 1C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 1D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 2A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 2B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 2C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 2D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 3A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 3B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 3C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 3D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 4A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 4B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 4C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 4D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 5A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 5B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 5C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 5D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 6A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 6B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 6C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 6D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 7A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 7C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 7D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 8A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 8B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 8C	ENBL	ENBL	ENBL	ENBL	

C/W INPUT 8D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 9A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 9B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 9C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 9D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 10A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 10B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 10C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 10D	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 11A	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 11B	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 11C	ENBL	ENBL	ENBL	ENBL	
C/W INPUT 11D	ENBL	ENBL	ENBL	ENBL	
PANEL 223					
R C/W TONE ADJUST	as desired	as desired	as desired	as desired	
L C/W TONE ADJUST	as desired	as desired	as desired	as desired	
CTR C/W TONE ADJUST	as desired	as desired	as desired	as desired	
PANEL 225					
cb PCM TLM ac GRP 1	close	close	close	close	
cb PCM TLM ac GRP 2	close	close	close	close	
cb FLT BUS MNA	close	close	close	close	
cb FLT BUS MNB	close	close	close	close	
cb PMP PRIM FLT BUS	close	close	close	close	
cb PMP AUX FLT BUS	close	close	close	close	
cb VHF/CREW AUDIO L FLT/PL	close	close	close	close	
cb VHF/CREW AUDIO CTR FLT/PL	close	close	close	close	
cb VHF/CREW AUDIO R FLT/PL	close	close	close	close	
cb UDL FLT BUS	close	close	close	close	
cb S DB XMTR/DSE FLT BUS	close	close	close	close	
cb S DB XMTR/DSE ac GRP 1	close	close	close	close	
cb CTE MNA	close	close	close	close	
cb CTE MNB	close	close	close	close	
cb SIG CONDR FLT BUS	close	close	close	close	

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 225 (CONT)					
cb S BD PWR AMPL 1 FLT BUS	close	close	close	close	
cb S BD PWR AMPL 1 ac GRP 1	close	close	close	close	
cb S BD PWR AMPL 2 FLT BUS	close	close	close	close	
cb S BD PWR AMPL 2 ac GRP 2	close	close	close	close	
PANEL 226					
cb FC 1 PUMPS AC	close	close	close	close	
cb FC 1 REACS BAT TLY	open	close	close	close	
cb FC 1 BUS CONT BAT RLY	close	close	close	close	
cb FC 1 PURG MNA	close	close	close	close	
cb FC 1 RAD BAT RLY	open	open	open	open	
cb CRYO H2 HTR 1 MNA	close	close	close	close	
cb CRYO H2 HTR 2 MNB	close	close	close	close	
cb FC 2 PUMPS AC	close	close	close	close	
cb FC 2 REACS BAT RLY	close	close	close	close	
cb FC 2 BUS CONT BAT RLY	close	close	close	close	
cb FC 2 PURG MNA	close	close	close	close	
cb FC 2 RAD BAT RLY	open	open	open	open	
cb CRYO 02 100 W HTR 1 MNA	close	close	close	close	
cb CRYO 02 100 W HTR 2 MNB	close	close	close	close	
cb FC 3 PUMPS AC	close	close	close	close	
cb FC 3 REACS BAT RLY	open	close	close	close	
cb FC 3 BUS CONT BAT RLY	close	close	close	close	
cb FC 3 PURG MNB	close	close	close	close	
cb FC 3 RAD BAT RLY	open	open	open	open	
cb CRYO 02 50 W HTR 1 MNA	close	close	close	close	
cb CRYO 02 50 W HTR 2 MNB	close	close	close	close	
cb CRYO CIR TK1 AC1 ØA	close	close	close	close	
cb CRYO CIR TK1 AC1 ØB	close	close	close	close	

| | | |

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 230					
cb UVA EXP MNB	open	open	open	open	
cb UVA COVER MNB	open	open	open	open	
UVA PWR	OFF	OFF	OFF	OFF	
UVA LAMPS	OFF	OFF	OFF	OFF	
UVA COVER	ctr	ctr	as req	ctr	
ETE PWR	OFF	OFF	OFF	OFF	
PANEL 250					
cb INV PWR 1 MNA	close	close	close	close	
cb INV PWR 2 MNB	close	close	close	close	
cb INV PWR 3 MNA	close	close	close	close	
cb INV PWR 3 MNB	close	close	close	close	
cb MN BUS INTERCONNECT MNA	open	open	open	open	
cb MN BUS INTERCONNECT MNB	open	open	open	open	
PANEL 251					
OVBD DRAIN vlv	OFF	OFF	OFF	OFF	
PANEL 252					
BAT VENT vlv	VENT	VENT	VENT	VENT	
WASTE STOW VENT vlv	CLOSE	VENT	CLOSE	CLOSE	

PANEL 274					
cb ELECTROPHORESIS MNA	close	close	close	open	
cb ELECTROPHORESIS MNB	close	close	close	open	
cb DM FURNACE/CRYSTAL GROWTH 1 - MNA	open	open	as req	open	
cb DM FURNACE/CRYSTAL GROWTH 2 - MNA	open	open	as req	open	
cb DM FURNACE/CRYSTAL GROWTH 2 - MNA	open	open	as req	open	
cb ETE AC2 ØA	open	open	open	open	
cb ETE AC2 ØB	open	open	open	open	
cb ETE AC2 ØC	open	open	open	open	
cb UV MNB	close	close	close	close	
cb VIDEO RCDR MNA	close	close	close	open	
cb VIDEO CAMR/MON MNA	close	close	close	open	
cb DS A IND LOGIC MNA	open	open	close	open	
cb DS A IND PWR AC1	open	open	close	open	
cb DS A CONTROL BAT A	open	open	open	open	
cb DS A MOTORS AC1 ØA	open	open	open	open	
cb DS A MOTORS AC1 ØB	open	open	open	open	
cb DS A MOTORS AC1 ØC	open	open	open	open	
cb DM POWER MNA	open	open	close	open	
cb DM POWER MNB	open	open	close	open	
TUNL LTS	OFF	OFF	OFF	OFF	
EXT RUN LTS	OFF	OFF	OFF	OFF	
EXT RNDZ LTS	OFF	OFF	OFF	OFF	
cb DS B IND LOGIC MNB	open	open	close	open	
cb DS B IND PWR AC2	open	open	close	open	
cb DS B CONTROL BAT B	open	open	open	open	
cb DS B MOTORS AC2 ØA	open	open	open	open	
cb DS B MOTORS AC2 ØB	open	open	open	open	
cb DS B MOTORS AC2 ØC	open	open	open	open	
cb SIVB/DM SEP PYRO A	close	close	open	open	
cb SIVB/DM SEP PYRO B	close	close	open	open	

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 275					
cb MNA BAT BUS A	close	close	close	close	
cb MNA BAT C	open	open	open	close	
cb MNB BAT C	open	open	open	close	
cb MNB BAT BUS B	close	close	close	close	
cb BAT BUS A BAT A	close	close	close	close	
cb BAT BUS A MNA	open	open	open	open	
cb BAT BUS A BAT C	open	open	open	open	
cb BAT BUS A PYRO BAT A	open	open	open	open	
cb BAT BUS B BAT B	close	close	close	close	
cb BAT BUS B MNB	open	open	open	open	
cb BAT BUS B BAT C	open	open	open	open	
cb BAT BUS B PYRO BAT B	open	open	open	open	
PANEL 276					
CB1 INST PWR CONT	close	close	close	close	
CB2 INST PWR CONT	close	close	close	close	
CB3 INST PWR CONT	close	close	close	close	
CB4 INST PWR CONT	close	close	close	close	
PANEL 278					
cb UPR SYS COMPR 1	open	open	open	open	
cb UPR SYS COMPR 2	open	open	open	open	
cb DOCK RING SEP BAT A	close	open	open	open	
cb DOCK RING SEP BAT B	close	open	open	open	
PANEL 300					
rh SUIT FLOW vlv	FULL FLOW	FULL FLOW	FULL FLOW	FULL FLOW	

PANEL 301					
lh SUIT FLOW vlv	FULL FLOW	FULL FLOW	FULL FLOW	FULL FLOW	
PANEL 302					
ctr SUIT FLOW vlv	FULL FLOW	FULL FLOW	FULL FLOW	FULL FLOW	
PANEL 303					
PRIM CAB TEMP vlv SEC CAB TEMP vlv	COLD (cw) MAX COOL (CW)	COLD (cw) MAX COOL (CW)	HOT (ccw) mid range	HOT (ccw) mid range	
PANEL 304					
DRINK H20 SUP vlv H20 gun probe safety H20 gun probe fire extg vlv	OFF (cw) push lock lock closed	OFF (cw) push lock lock closed	OFF (cw) push lock lock closed	OFF (cw) push lock lock closed	
PANEL 305					
FOOD PREP COLD H20 vlv FOOD PREP HOT H20 vlv	rel rel	rel rel	rel rel	rel rel	
PANEL 306					
MSN TMR EVNT TMR RSET EVNT TMR START EVNT TMR MIN EVNT TMR SEC MSN TMR HRS MSN TMR MIN MSN TMR SEC	START UP (ctr) ctr ctr ctr ctr ctr ctr	START UP (ctr) ctr ctr ctr ctr ctr ctr	START UP (ctr) ctr ctr ctr ctr ctr ctr	START UP (ctr) ctr ctr ctr ctr ctr ctr	

PANELS 275 THRU 306

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 325					
rh CAB PRESS RELF vlv	BOOST/ENTR	BOOST/ENTR	NORM	NORM	
lh CAB PRESS RELF vlv	BOOST/ENTR	BOOST/ENTR	NORM	NORM	
PRIM GLY TO RAD	NORM (in)	BYP (pull)	NORM (in)	NORM (in)	
PANEL 326					
REPRESS PKG O2 vlv	OFF	ON	OFF	ON	
SM O2 SUP vlv	ON	ON	ON	ON	
SRG TK O2 vlv	ON	ON	ON	ON	
GLY RSVR IN vlv	OPEN	OPEN	CLOSE	CLOSE	
GLY RSVR BYP vlv	CLOSE	CLOSE	OPEN	OPEN	
GLY RSVR OUT vlv	OPEN	OPEN	CLOSE	CLOSE	
PANEL 350					
CO2 CSTR DIVERT vlv	ctr	ctr	ctr	ctr	
PANEL 351					
MN REG A	OPEN	OPEN	OPEN	OPEN	
MN REG B	OPEN	OPEN	OPEN	OPEN	
H2O/GLY TK REG sel	BOTH	BOTH	BOTH	BOTH	
H2O/GLY TK RELF sel	BOTH	BOTH	BOTH	BOTH	
EMER CAB PRESS sel	OFF	OFF	BOTH	BOTH	
CAB REPRESS vlv	OFF (ccw)	OFF (ccw)	OFF (ccw)	OFF (ccw)	
PANEL 352					
WASTE TK SERV vlv	CLOSE	CLOSE	CLOSE	CLOSE	
PRESS RELF sel	RELF	RELF	RELF	RELF	
POT TK IN vlv	CLOSE	as req	OPEN	OPEN	
WASTE TK IN vlv	AUTO	AUTO	AUTO	AUTO	

PANEL 375					
02 SRG TK RELF vlv	OPEN (cw)	OPEN (cw)	OPEN (cw)	OPEN (cw)	
PANEL 376					
PLVC sw	NORM	NORM	NORM	NORM	
PANEL 377					
GLY TO RAD SEC vlv	BYP	BYP	BYP	BYP	
PANEL 378					
PRIM GLY ACCUM vlv	open (ccw)	open (ccw)	open (ccw)	open (ccw)	
PANEL 379					
PRIM ACCUM FILL vlv	OFF	OFF	OFF	OFF	
PANEL 380					
DEMAND REG sel SUIT TEST vlv SUIT RETURN vlv	BOTH OFF close (push)	BOTH OFF close (push)	BOTH OFF open (pull)	BOTH OFF open (pull)	
PANEL 382					
SUIT FLOW RELF GLY EVAP IN TEMP vlv SUIT HT EXCH SEC GLY SEC EVAP H20 CONT PRIM EVAP H20 CONT H20 ACCUM 1 H20 ACCUM 2	OFF MIN (ccw) (push) FLOW AUTO AUTO RMTE RMTE	OFF MIN (ccw) (push) FLOW AUTO AUTO RMTE RMTE	OFF MAX (cw) (push) BYP OFF OFF RMTE RMTE	OFF MAX (cw) (push) FLOW AUTO AUTO RMTE RMTE	

PANELS 325 THRU 382

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	POWER DOWN (FLIGHT)	QUIESCENT MODE (DOCKING)	AT CSM/SWS SEPARATION
PANEL 400					
TELEMETRY PWR	OFF	OFF	ON	OFF	
INTRLVR PWR	OFF	OFF	ON	OFF	
VTR PWR	OFF	OFF	ON	OFF	
HEADWHEEL DR MOT	ctr	ctr	as req	ctr	
TAPE MODE	ctr	ctr	as req	ctr	
TAPE DRIVE	ctr	ctr	as req	ctr	
TAPE HEAD CLEAN	NORM	NORM	NORM	NORM	
LAMP TEST	STATUS	STATUS	STATUS	STATUS	
PANEL 426					
VIDEO PWR	OFF	OFF	as req	as req	
VIDEO SOURCE	CM	CM	as req	as req	
VIDEO TV MODE	PLAYBACK	PLAYBACK	as req	as req	
PANEL 600					
EMER O2 VLV	CLOSE	CLOSE	CLOSE	CLOSE	
PANEL 601					
REPRESS O2 VLV	CLOSE (guarded)	CLOSE (guarded)	CLOSE (guarded)	CLOSE (guarded)	
PANEL 602					
REPRESS O2 RELF VLV	OPEN (cw)	OPEN (cw)	OPEN (cw)	OPEN (cw)	
PANEL 603					
IVA STA O2 SUP	OFF	OFF	OFF	OFF	

PANEL 604					
IVA PWR	OFF	OFF	OFF	OFF	
FWD HATCH					
PRESS EQUAL vlv Actr handle sel Actr handle rel	CLOSE stowed locked	CLOSE stowed locked	OPEN stowed locked	CLOSE stowed locked	
SIDE HATCH					
CAB PRESS DUMP vlv Gearbox sel Actr handle sel BPC jett knob Lockpin rel knob GN2 vlv handle Lockpin ind	close (cw) LATCH L (latch) 180° from BPC JETT decal UNLOCK neutral flush	close (cw) LATCH U (unlatch) Arrow on knob pointing to BPC JETT decal LOCK push (outboard) flush	close (cw) LATCH L (latch) 180° from BPC JETT decal UNLOCK neutral flush	close (cw) LATCH L (latch) 180° from BPC JETT decal UNLOCK neutral flush	

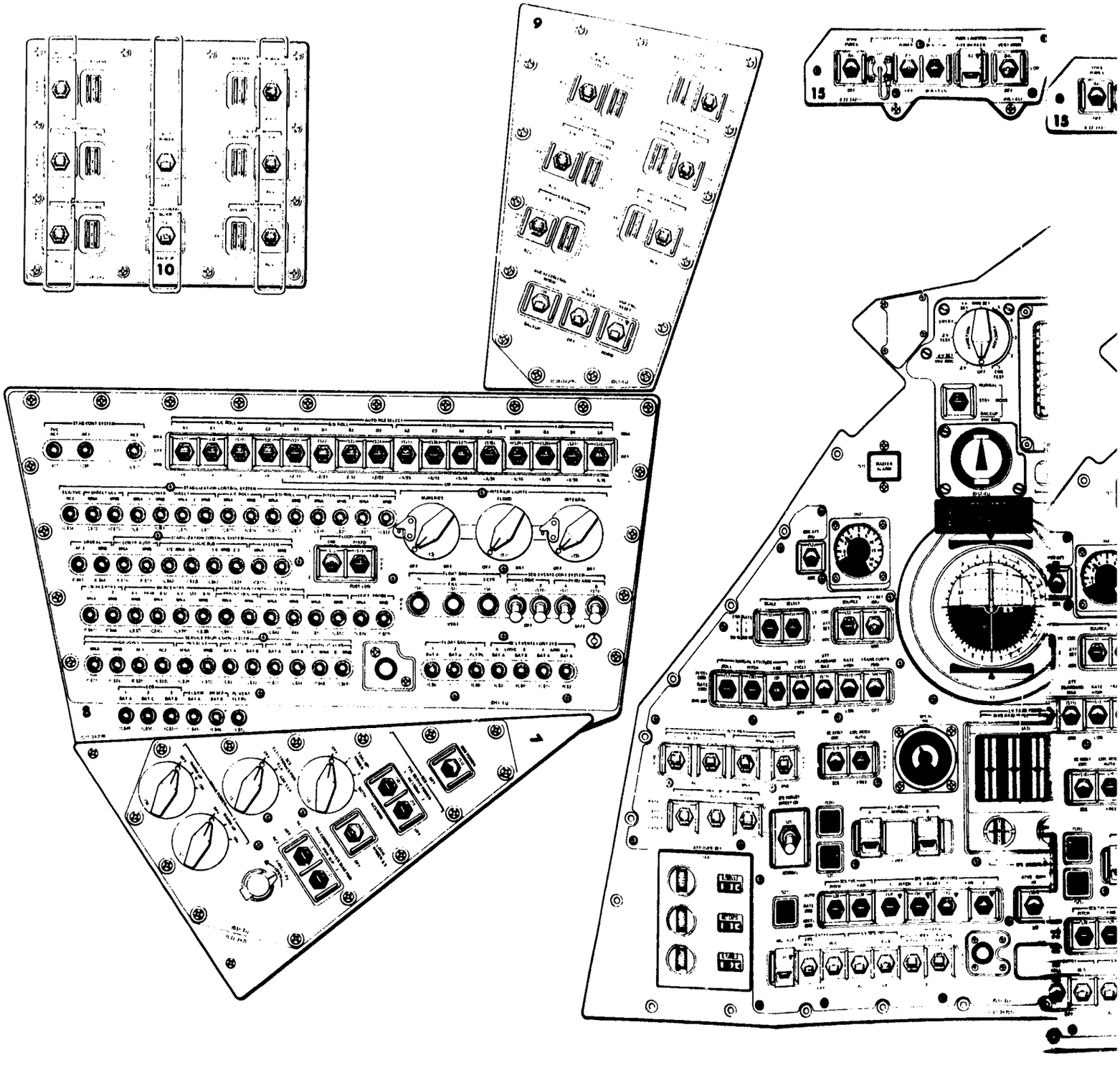
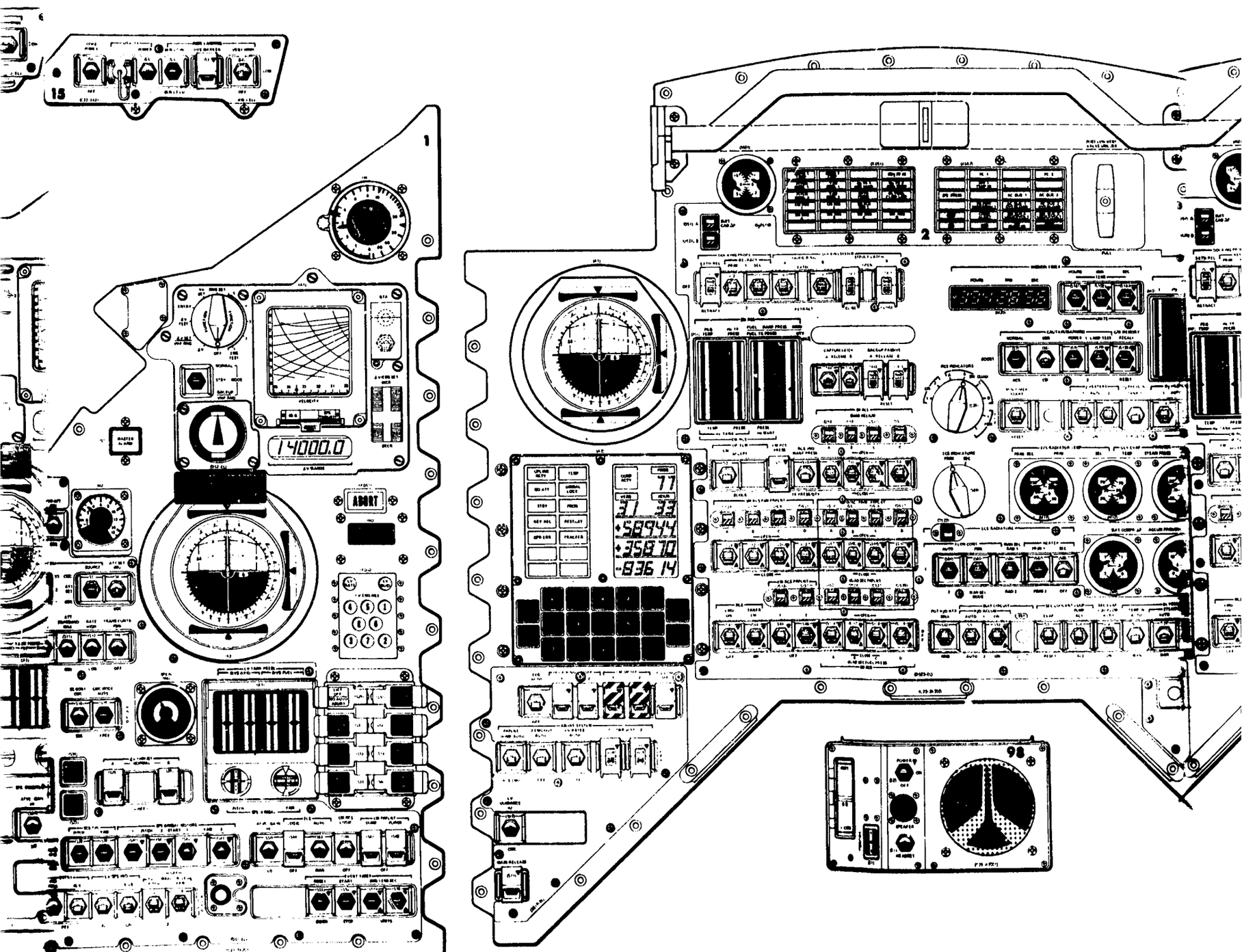


Figure A-1. Crew Displays and Controls (Sheet 1 of 5)

FOLDOUT FRAME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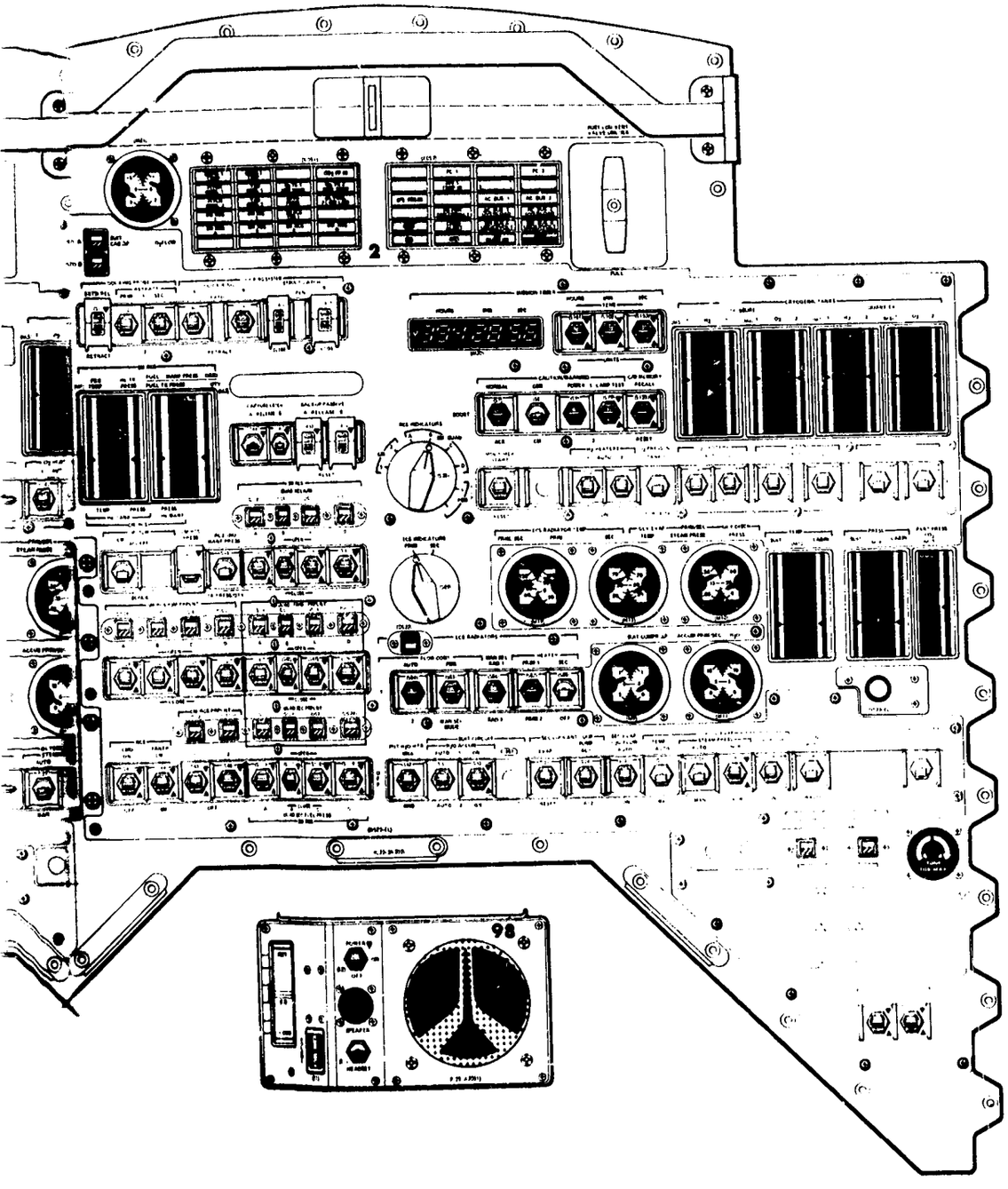

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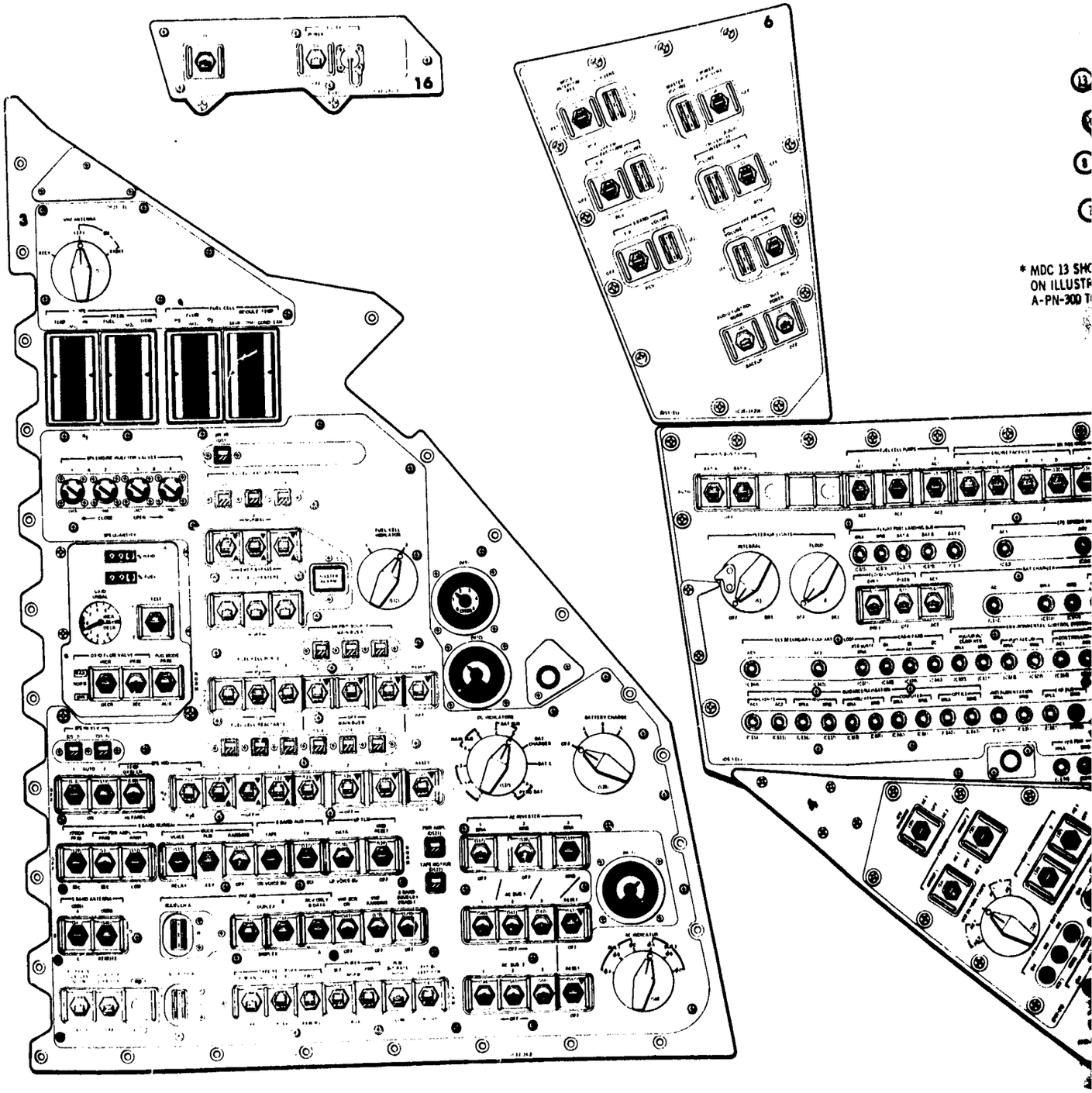
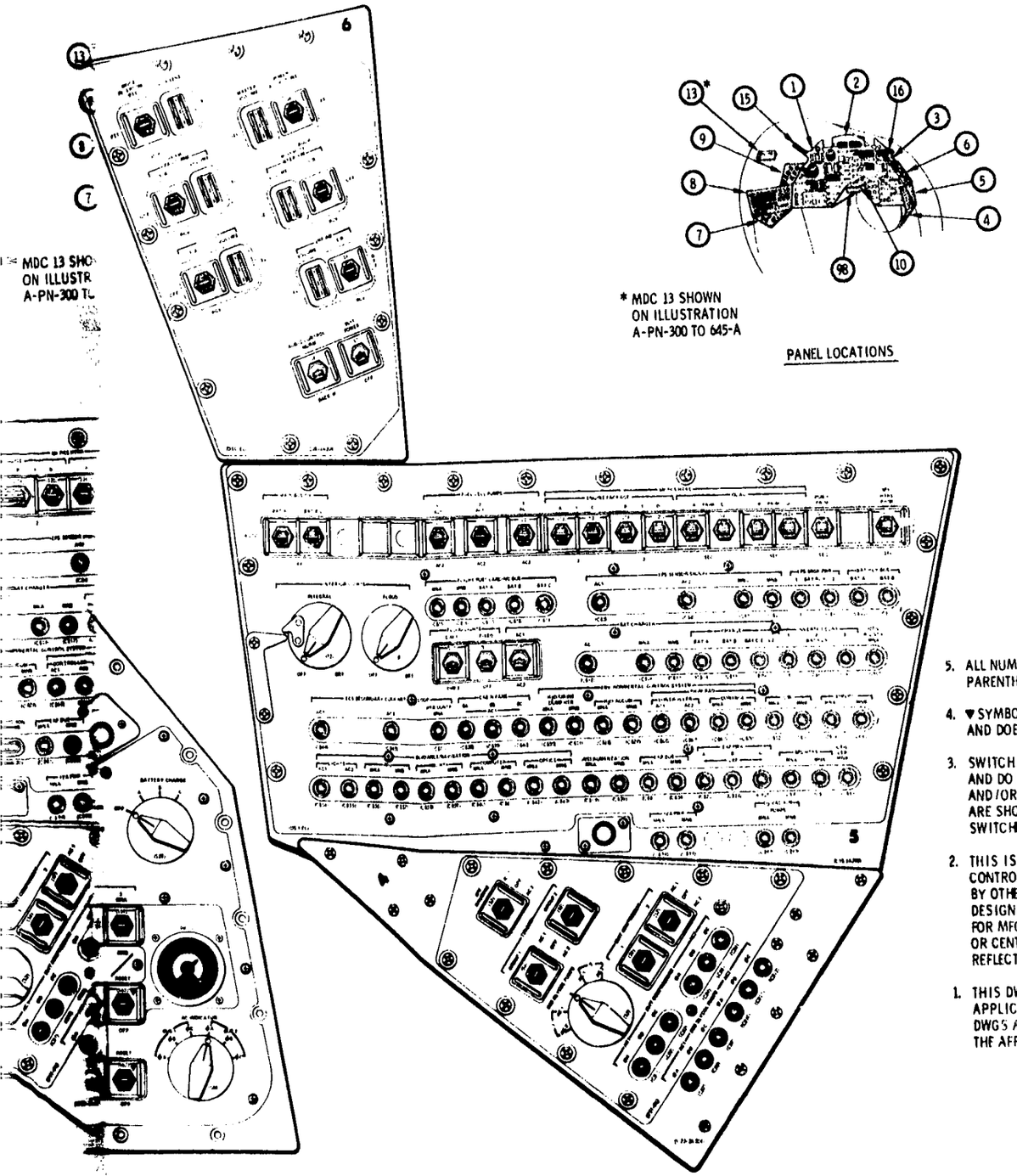


* MDC 13 SHO
ON ILLUSTR
A-PN-300 T

Figure A-1. Crew Disp



* MDC 13 SHOWN ON ILLUSTRATION A-PN-300 TO 645-A

PANEL LOCATIONS

5. ALL NUMBERS AND LETTERS ENCLOSED WITH PARENTHESIS DO NOT APPEAR ON PANELS.

4. ▼SYMBOL DENOTES MOMENTARY SWITCH POSITION AND DOES NOT APPEAR ON PANELS.

3. SWITCH POSITIONS ARE SHOWN FOR CONVENIENCE ONLY AND DO NOT NECESSARILY REFLECT OPERATING MODES AND/OR MISSION PHASES. TWO POSITION SWITCHES ARE SHOWN IN THE DOWN POSITION. THREE POSITION SWITCHES ARE SHOWN IN CENTER POSITION.

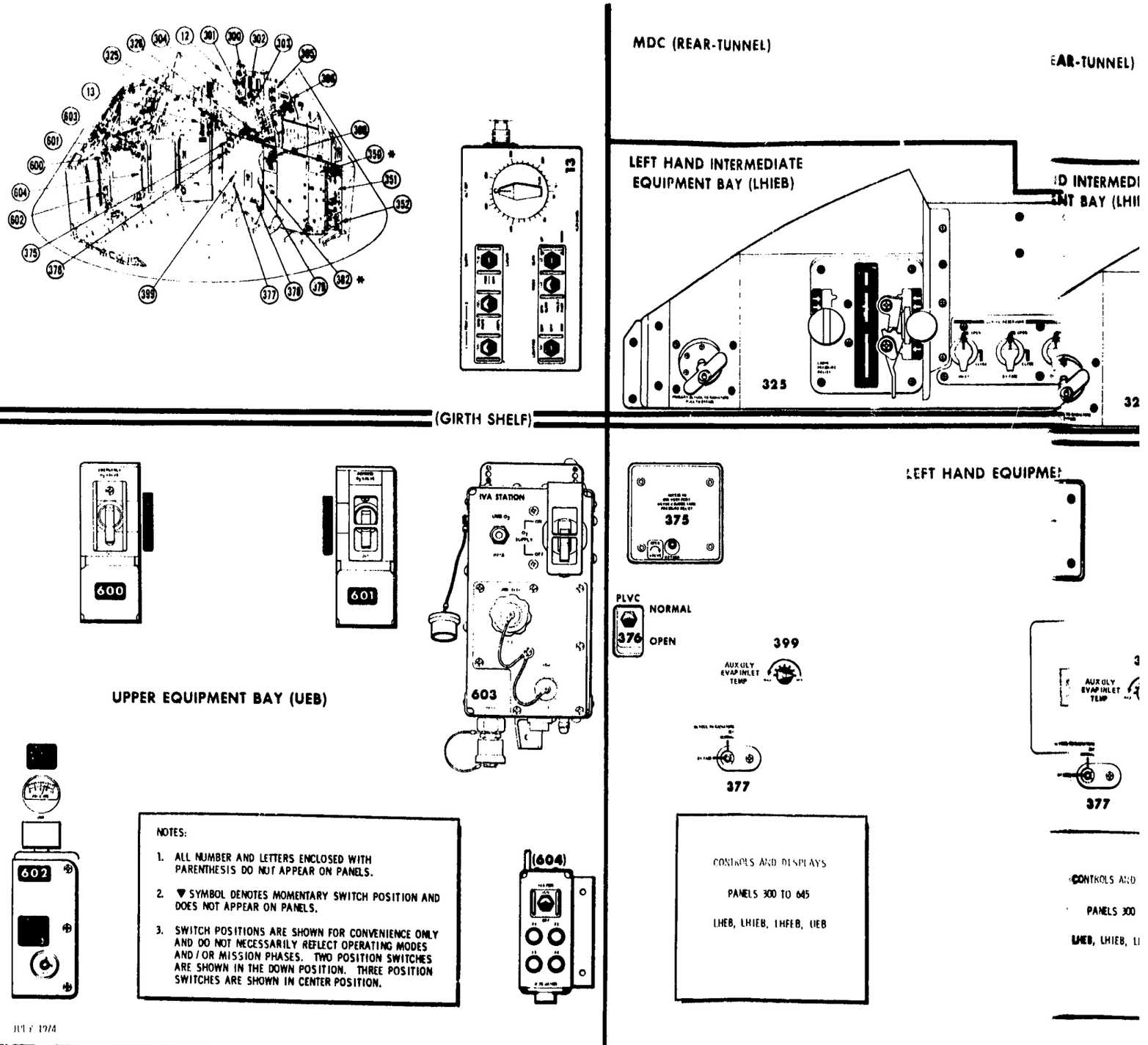
2. THIS IS AN ARRANGEMENT AND NOMENCLATURE CONTROL DWG FOR DESIGN REQUIREMENTS AND FOR USE BY OTHER DEPTS AS A GUIDE. ONLY RELEASED DESIGN DRAWINGS AND DOCUMENTS SHALL BE USED FOR MFG, MOCKUP, SIMULATOR, EVALUATOR, TRAINER OR CENTRIFUGE PANELS WHICH ARE INTENDED TO REFLECT CURRENT DESIGN.

1. THIS DWG REFLECTS A CONFIGURATION AS DEFINED BY APPLICABLE SCD'S, ASSEMBLY DWGS AND MARKING DWGS AS OF THE DATE OF RELEASE WITH RESPECT TO THE AFFECTED VEHICLES.

ASTP-MDC-1-10-98-119A

CSM LOGISTICS TRAINING

Figure A-1. Crew Displays and Controls (Sheet 2 of 5)



FOLDOUT FRAME

Figure A-1. Crew Displays and Controls (Sheet 3 of 5)

AR-TUNNEL)

D INTERMEDIATE
NT BAY (LHIEB)

12

300

301

302

303

305

FOOD PREPARATION WATER

SECONDARY CABIN TEMP

PRIMARY CABIN TEMP

CTR

L

R

326

325

LEFT HAND FORWARD EQUIPMENT BAY (LHFEB)

304

(GIRTH SHELF)

ME

LEFT HAND EQUIPMENT BAY (LHEB)

380

CAUTION

SUIT CIRCUIT RETURN VALVE PULL TO OPEN PUSH TO CLOSE

*350

CO_2 CANISTER DIVERTER VALVE

399

AUX GLY EVAP INLET TEMP

379

377

382

378

CONTROLS AND DISPLAYS

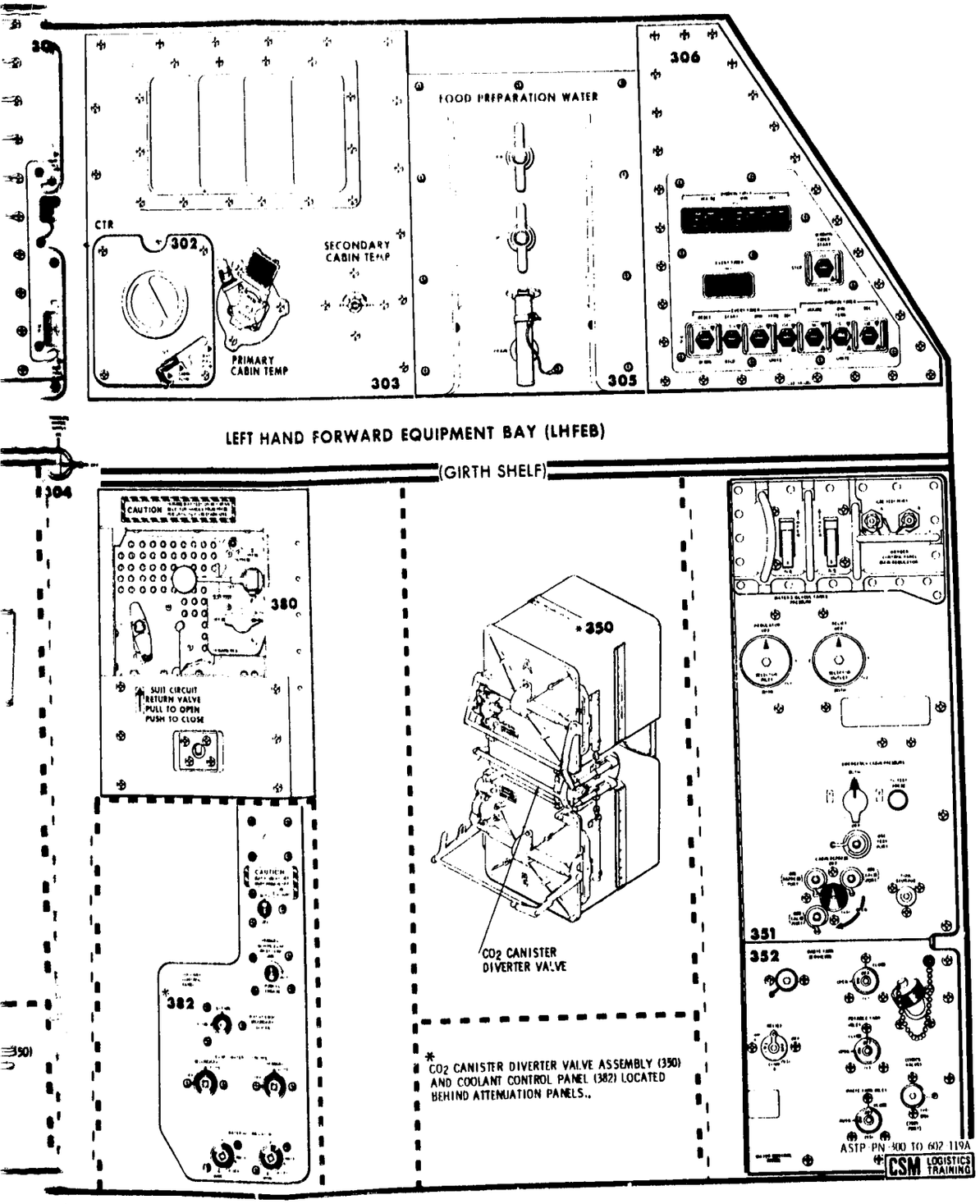
PANELS 300 TO 645

LHEB, LHIEB, LHFEB, UEB

* CO_2 CANISTER DIVERTER VALVE ASSEMBLY (350) AND COOLANT CONTROL PANEL (382) LOCATED BEHIND ATTENUATION PANELS.

5)

(119) A-39/A-40 FOLDOUT FRAME



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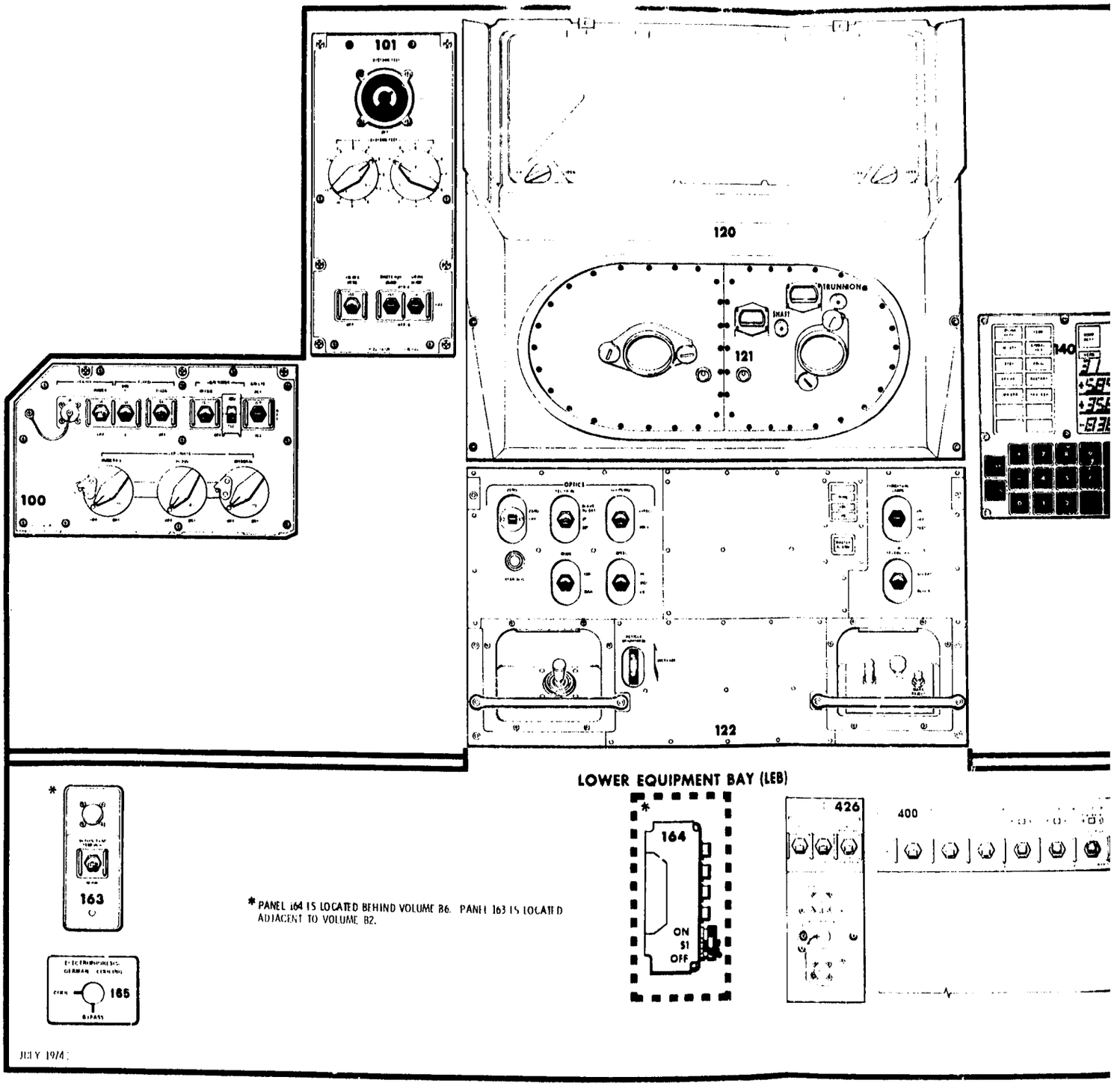

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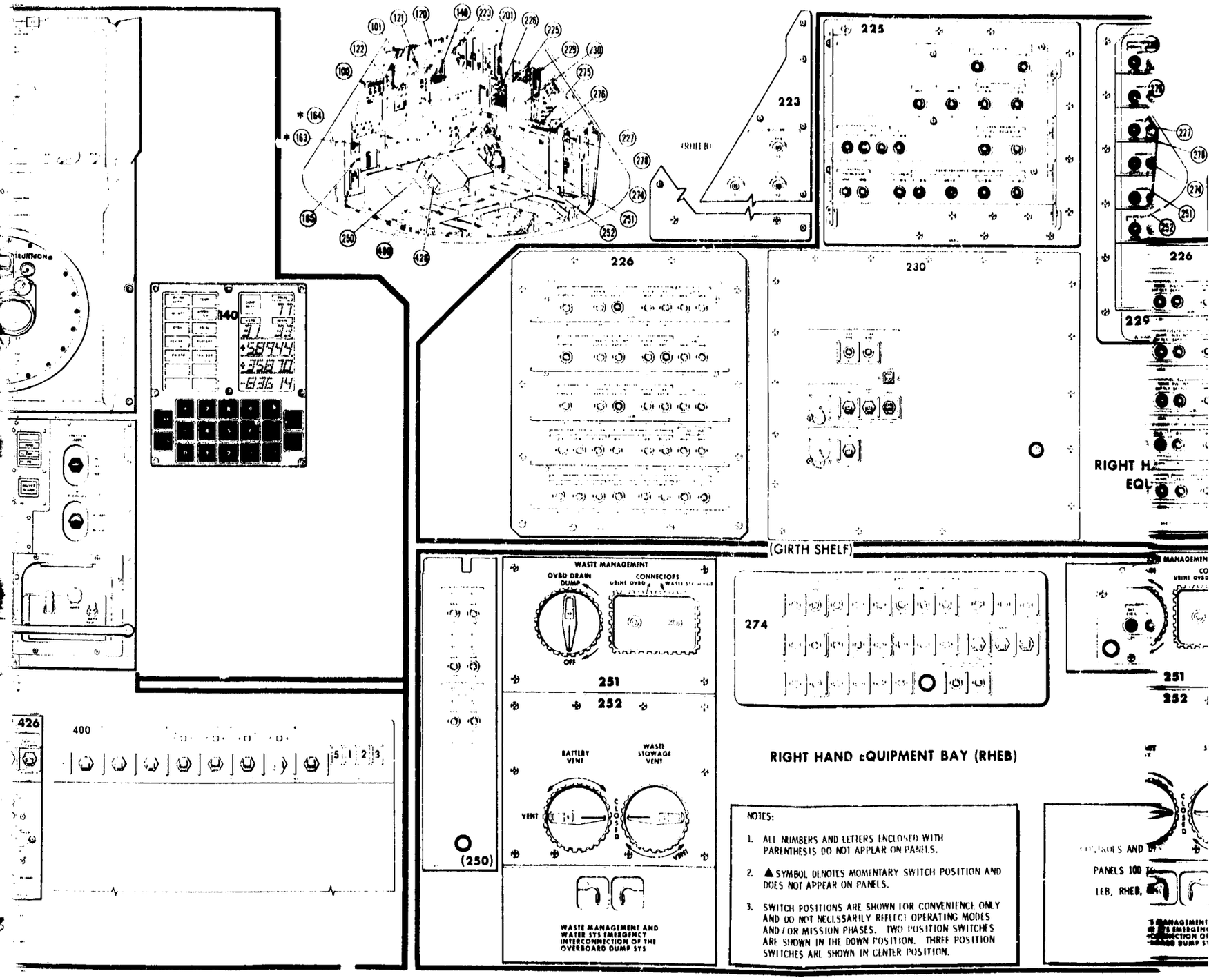


Figure A-1. Crew Displays and Control

FOLDOUT FRAME

Basic Date 15 July 1974 Change Date _____

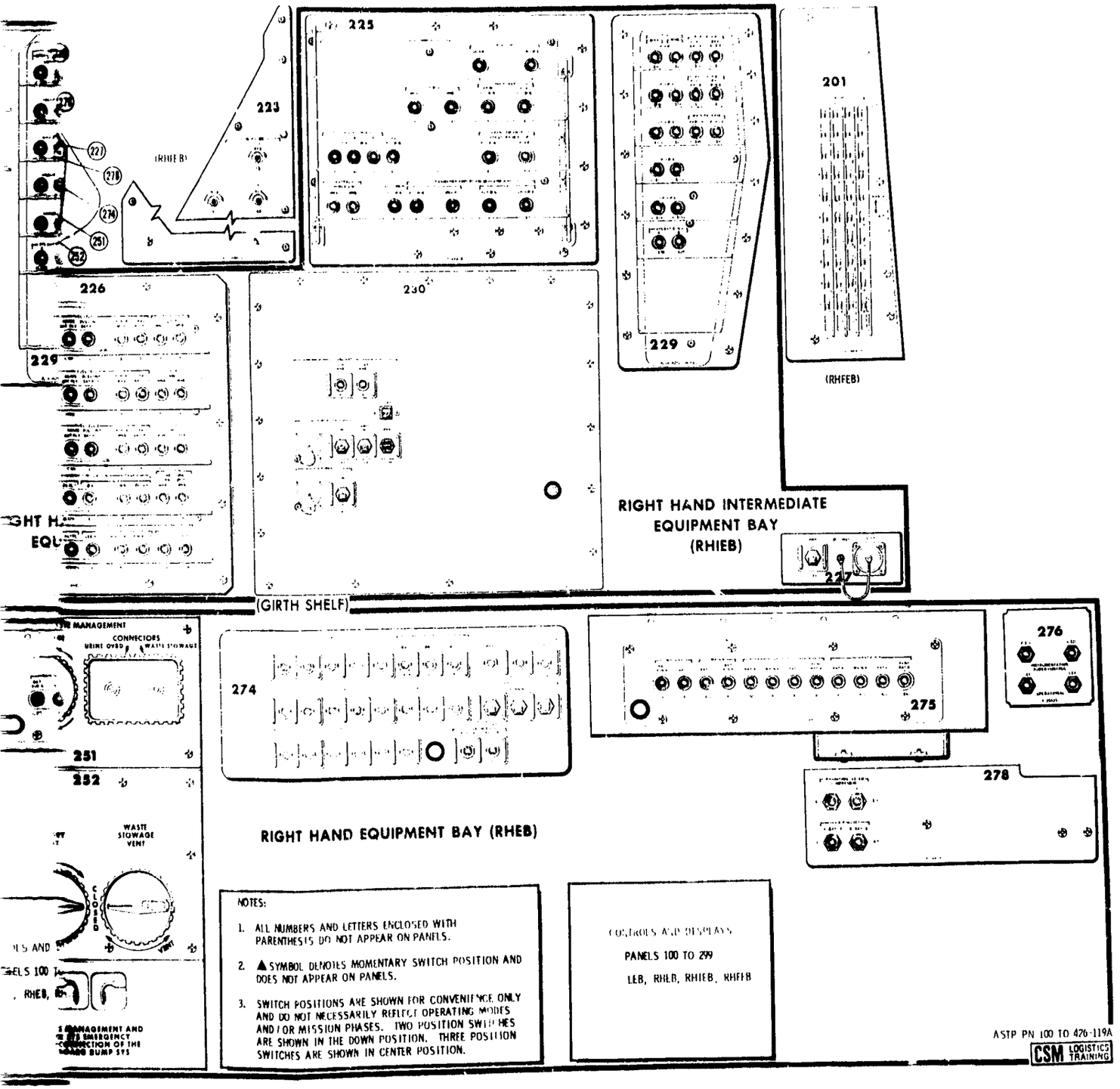
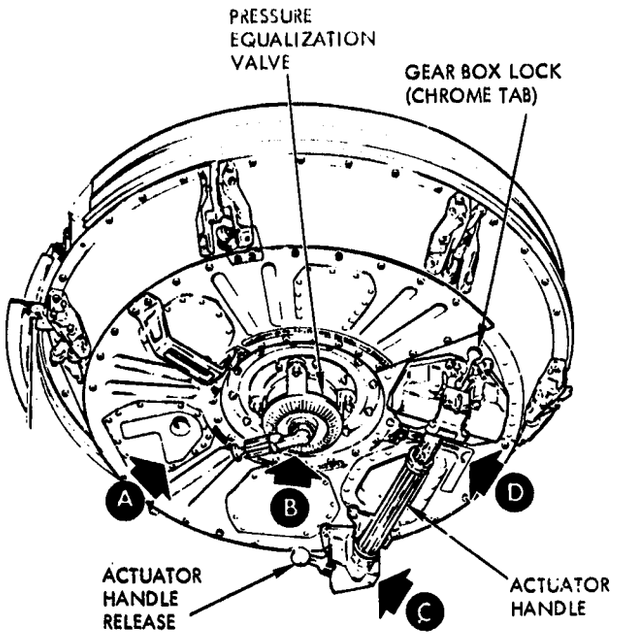
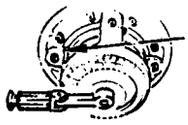


Figure A-1. Crew Displays and Controls (Sheet 4 of 5)

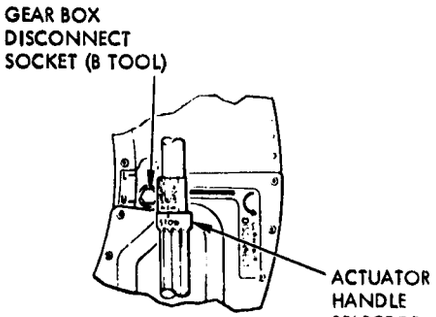
FORWARD HATCH



DETAIL A

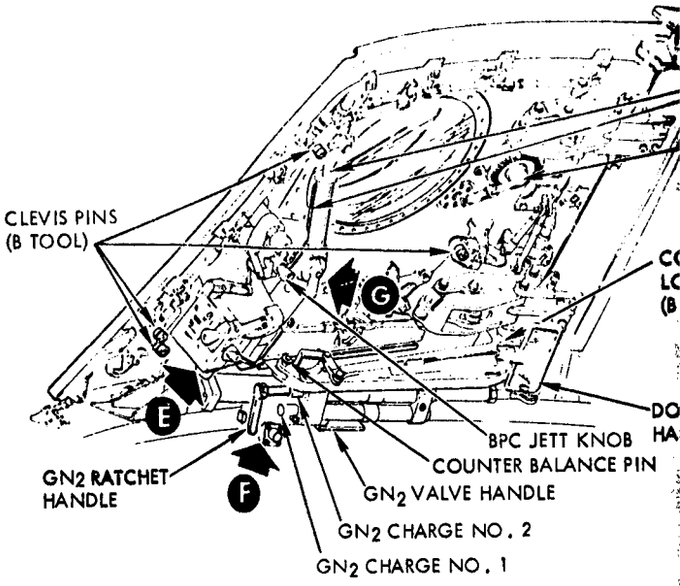


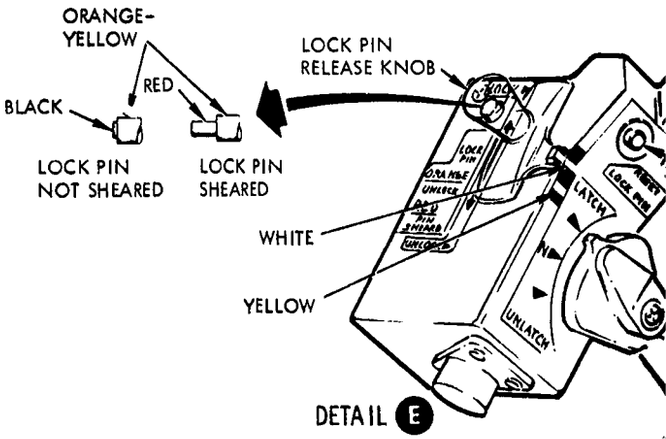
DETAIL B



DETAIL D

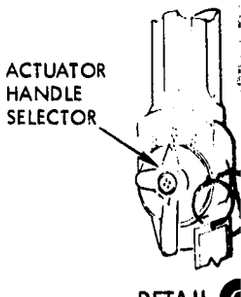
SIDE HATCH





DETAIL E

DETAIL F



DETAIL

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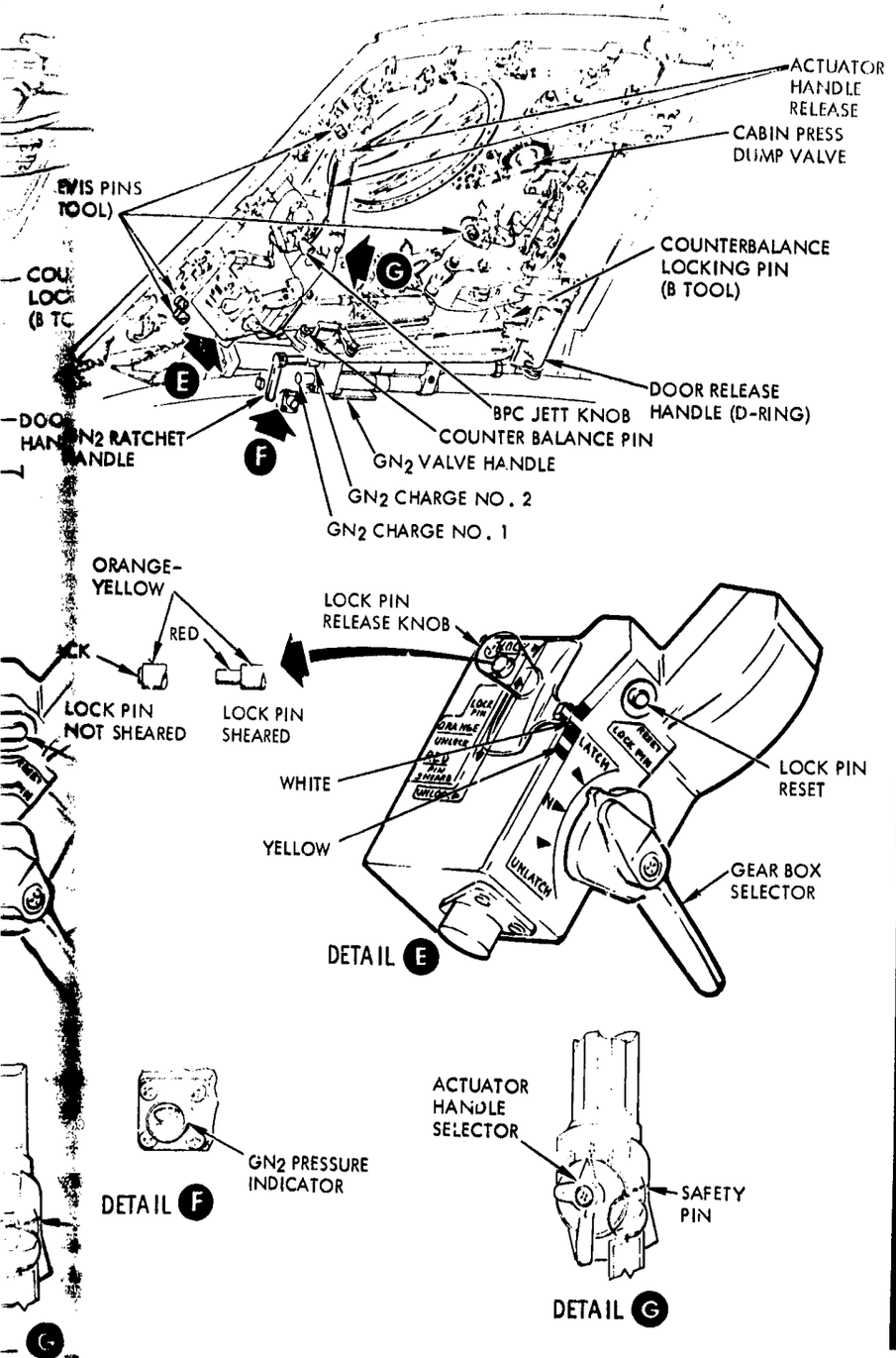
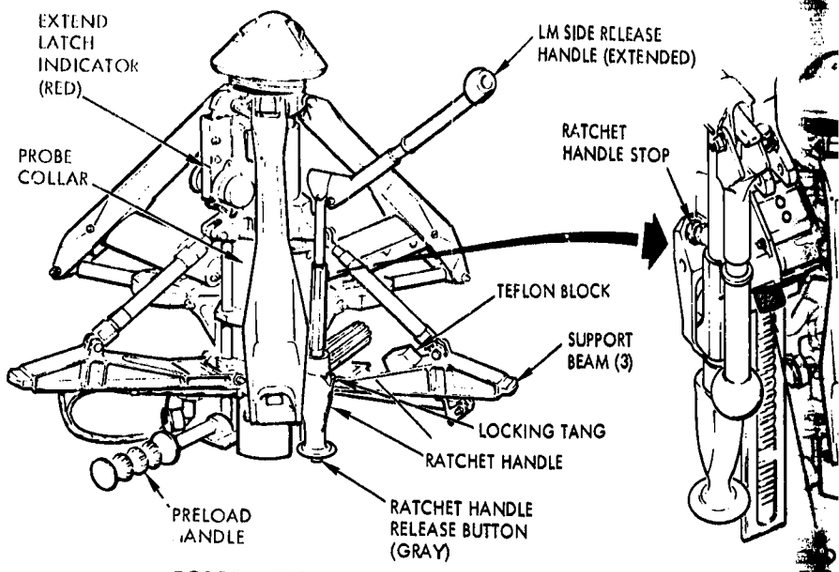
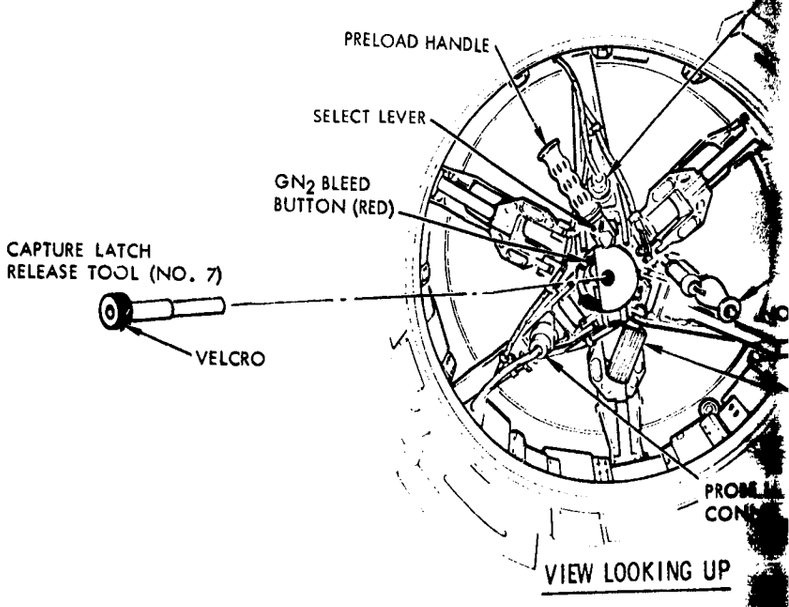
SIDE HATCH



PROBE & TUNNEL



PROBE ASSEMBLY



VIEW LOOKING UP

Figure A-1. Crew Di

FOLDOUT FRAM

PROBE & TUNNEL LATCHES

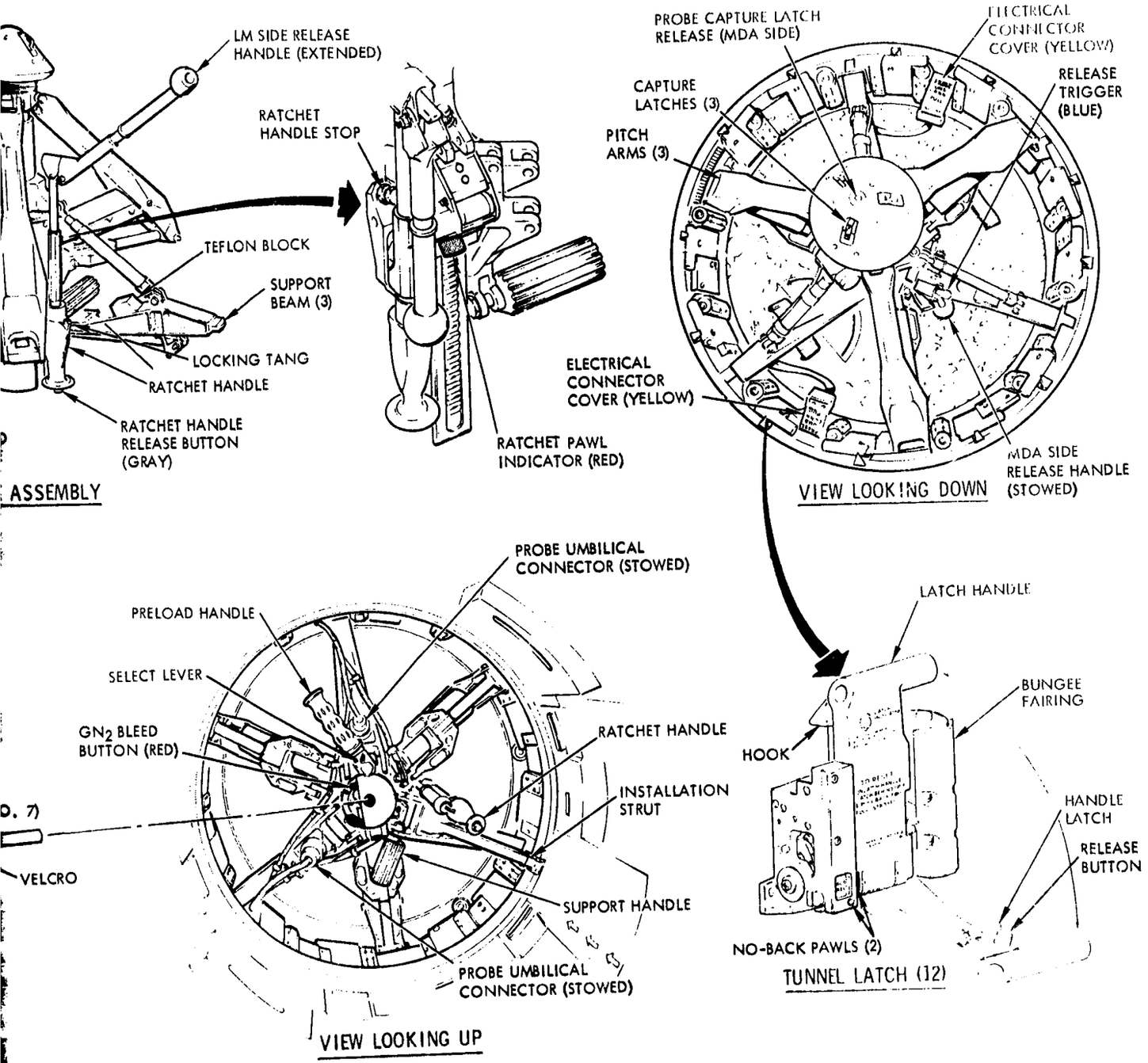


Figure A-1. Crew Displays and Controls (Sheet 5 of 5)

APPENDIX B

DM PANEL ILLUSTRATIONS AND CONTROL/INDICATOR CONFIGURATION LIST

This section contains DM panel illustrations and a control/indicator configuration list for DM _. Panel illustrations present the location of the displays and controls as they appear on the panels in the DM (Figure B-1). The control/indicator configuration list provides the configuration of the DM displays and controls at lift-off, during the docked-occupied periods, the docked-unoccupied periods and the final closeout configuration which is synonymous with the DM jettison configuration.

A control or switch setting in brackets [] indicates a DM docked and occupied in a Soyuz high pressure mode.

DOCKING MODULE SWITCH CONFIGURATIONS				
	LIFTOFF	DOCKED - OCCUPIED	DOCKED - UNOCCUPIED	CLOSEOUT CONFIGURATION
PANEL 803				
DM/SOYUZ TUNL VENT ISOL vlv	CLOSE	CLOSE	CLOSE	CLOSE
DM SOYUZ TUNL VENT vlv	CLOSE	CLOSE	CLOSE	CLOSE
PANEL 808				
UTILITY POWER	OFF	OFF	OFF	OFF
TV STATION SEL DM/SOYUZ	DM	as req	UP TLM	DM
TV STATION SEL DM1/DM2	DM1	as req	UP TLM	DM1
CAMR SYNC	CM/DM	as req	CM/DM	CM/DM
DM1 TV STATION POWER	OFF	as req	OFF	OFF
DM2 TV STATION POWER	OFF	as req	OFF	OFF
PANEL 811				
AUDIO 1 POWER	OFF	OFF	OFF	OFF
PANEL 815				
DOPPLER MNTR	OFF	as req	as req	OPERATE
S5 DOPPLER MNTR DMA	open	as req	as req	open

cb WALL HTRS DMA	close	open	close	open
cb WALL HTRS DMB	close	open	close	open
cb CABIN FAN DMA	close	close	close	open
cb CAUT WARN DMB	open	close	open	open
cb INST DMA	close	close	close	open
cb INST DMB	close	close	close	open
cb LIGHTING 1-DMA	open	close	close	open
cb LIGHTING 2-DMB	close	close	close	open
cb UTILITY DMA	open	close	close	open
cb VHF FM XCVR DMA	close	close	close	open
cb IM AUDIO/TV DMB	open	close	close	open
cb SOYUZ POWER DMB	open	open	open	open
cb DMA/DMB TIE	open	open	open	open
LIGHTING 1	OFF	OFF	OFF	OFF
LIGHTING 2	START	ON	ON	START
PANEL 818				
AUDIO 2 POWER	OFF	ON	OFF	OFF

PANELS 803 THRU 818

	LIFTOFF	DOCKED - OCCUPIED	DOCKED - UNOCCUPIED	CLOSEOUT CONFIGURATION
PANEL 821				
HIGH PRESS RELIEF 1 vlv	AUTO	AUTO	AUTO	AUTO
HIGH PRESS RELIEV 2 vlv	AUTO	AUTO	AUTO	AUTO
PANEL 824				
DM N2 PRESS vlv	OFF	OFF	OFF	OFF
DM N2 PRESS ISOL vlv	CLOSE	OPEN	OFF	OFF
O2 REG A vlv	OFF	ON	OFF	OFF
O2 REG B vlv	OFF	ON	OFF	OFF
SUPPLEMENTAL O2 FLOW vlv	OFF	OFF	OFF	OFF
O2 PURGE vlv	close (cw)	close (cw)	close (cw)	close (cw)
PRESS RELIEF VLV REF	DM	DM	DM	DM
PANEL 826				
EMER PRESS REG vlv	OFF	BOTH	OFF	OFF

PANEL 828				
MASK O2 vlv	OFF	OFF	OFF	OFF
O2 PURGE PRESS RELIEF vlv	CLOSE	CLOSE	CLOSE	CLOSE
LOW PRESS RELIEF vlv	CLOSE	CLOSE	CLOSE	CLOSE
PANEL 856				
DOCK SYS A TEST SEL	OFF	OFF	OFF	OFF
DOCK SYS B TEST SEL	OFF	OFF	OFF	OFF
PANEL 860				
XMIT T'COM	OFF	as req	OFF	OFF
POWER	OFF	ON	ON	OFF
SIGNAL	OFF	on(up)	on(up)	OFF
VOLUME tw	decr	as req	as req	decr
PANEL 861 (RUSSIAN J-BOX)				
MICROPHONE	OFF	as req	OFF	OFF
TV CAMERA-1	OFF	as req	OFF	OFF
TV CAMERA-2	OFF	as req	OFF	OFF
VHF - D volume	decr (ccw)	as req	as req	decr (ccw)

PANELS 821 THRU 861

	LIFTOFF	DOCKED - OCCUPIED	DOCKED - UNOCCUPIED	CLOSEOUT CONFIGURATION
CMF INTERCOM volume	decr (ccw)	as req	as req	decr (ccw)
PANEL 962				
SUITE RING ENDS LIMIT SW	NORMAL	NORMAL	NORMAL	NORMAL
SUITE RING RETR LIMIT SW	NORMAL	NORMAL	NORMAL	NORMAL
CB CRYSTAL GROWTH MDIA	open	as req	open	open
CRYSTAL GROWTH PWR	OFF	as req	OFF	OFF
PANEL 900				
EM VENT ISOL vlv	CLOSE	CLOSE	CLOSE	CLOSE
EM VENT vlv	CLOSE	CLOSE	CLOSE	CLOSE
TUNL PRESS RELF vlv	cap - off	cap - on	cap - off	cap - off
PANEL 901				
EM PRESS ISOL vlv	CLOSE	CLOSE	CLOSE	CLOSE
EM PRESS vlv	OFF	OFF	OFF	OFF
PANEL 960 (LOCATED IN SOYUZ)				
MDIT I'COM	N/A	off (ctr)	off (ctr)	off (ctr)
POWER	N/A	ON	ON	OFF

APOLLO-SOYUZ TEST PROJECT (ASTP)
CREW STATION
MODIFIED CREW HANDBOOK

SECURE	N/A	ON	ON	OFF
VOLTS dc	N/A	as req	decr	decr
PANEL 961 (LOCATED IN SOYUZ)				
AUDIO POWER	N/A	ON	ON	OFF
TV CAM POWER	N/A	ON	ON	OFF
HATCH 1				
PRESS EQUAL VLV	CLOSE	N/A	N/A	CLOSE
HATCH 2				
PRESS EQUAL VALVE	CLOSE	OPEN [CLOSE]	CLOSE	CLOSE
HATCH 3				
PRESS EQUAL VALVE	CLOSE	CLOSE [OPEN]	CLOSE	CLOSE

PANELS 662 THRU 961 AND HATCHES

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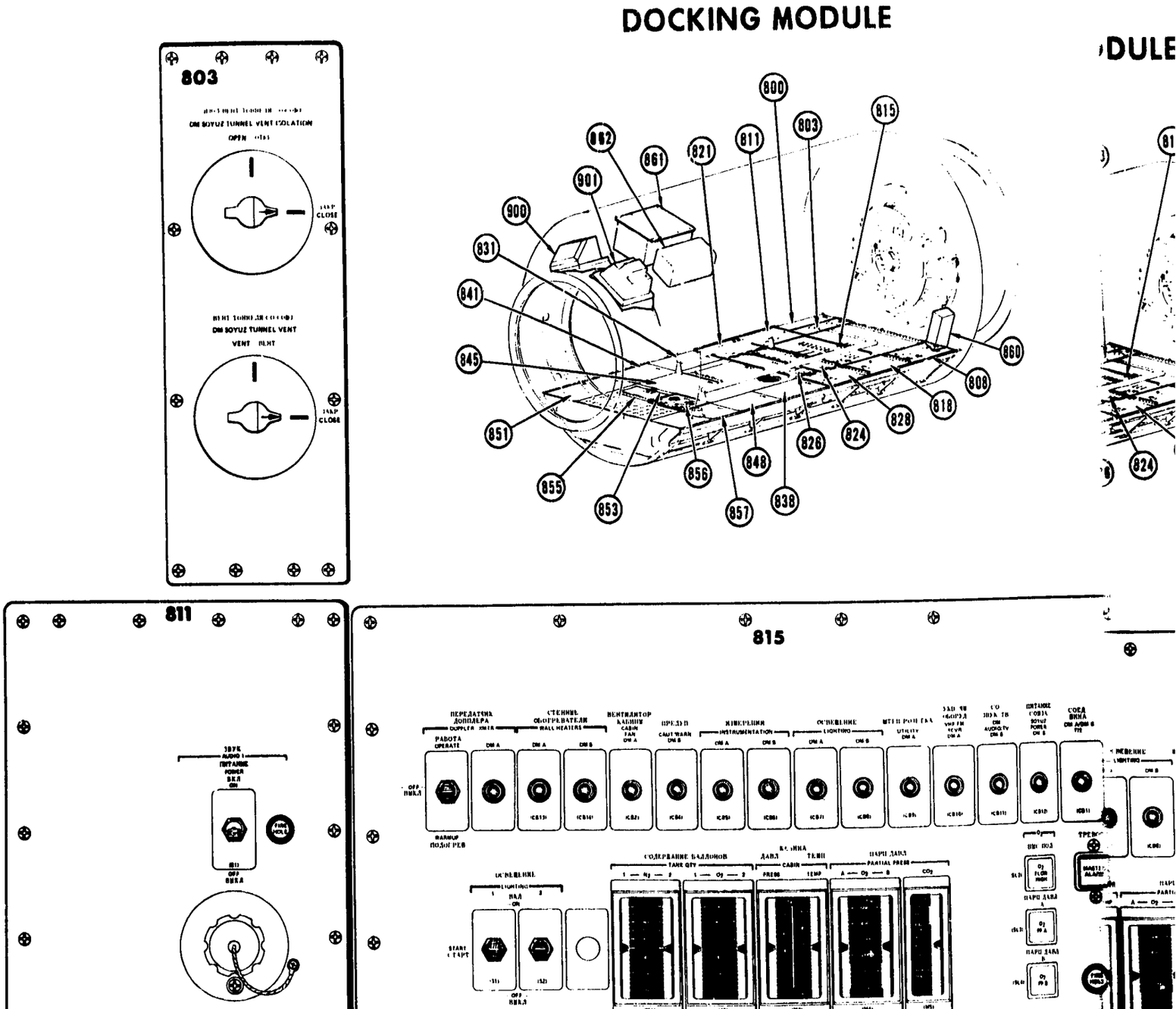

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Figure B-1. DM Crew Displays and Controls (Sheet 1 of 3)

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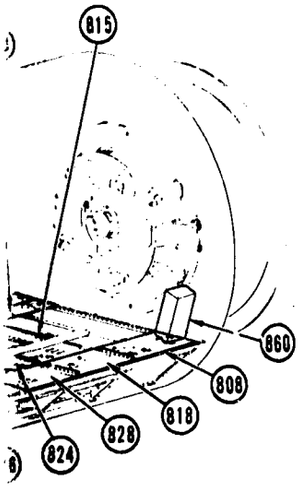

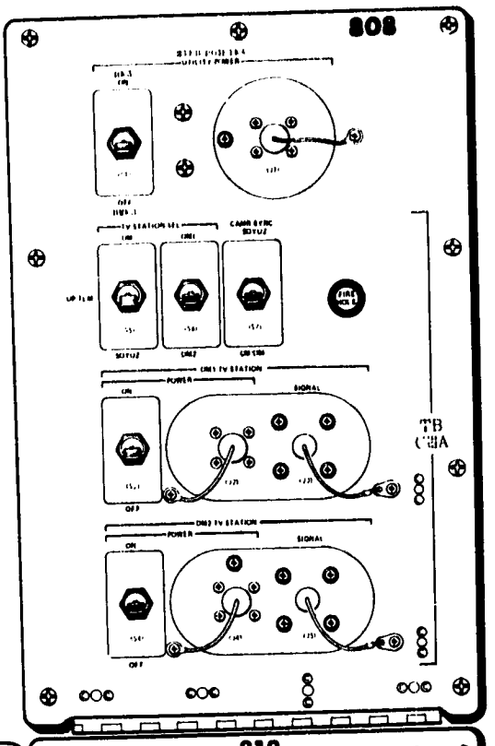

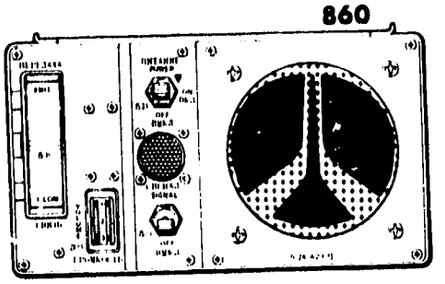

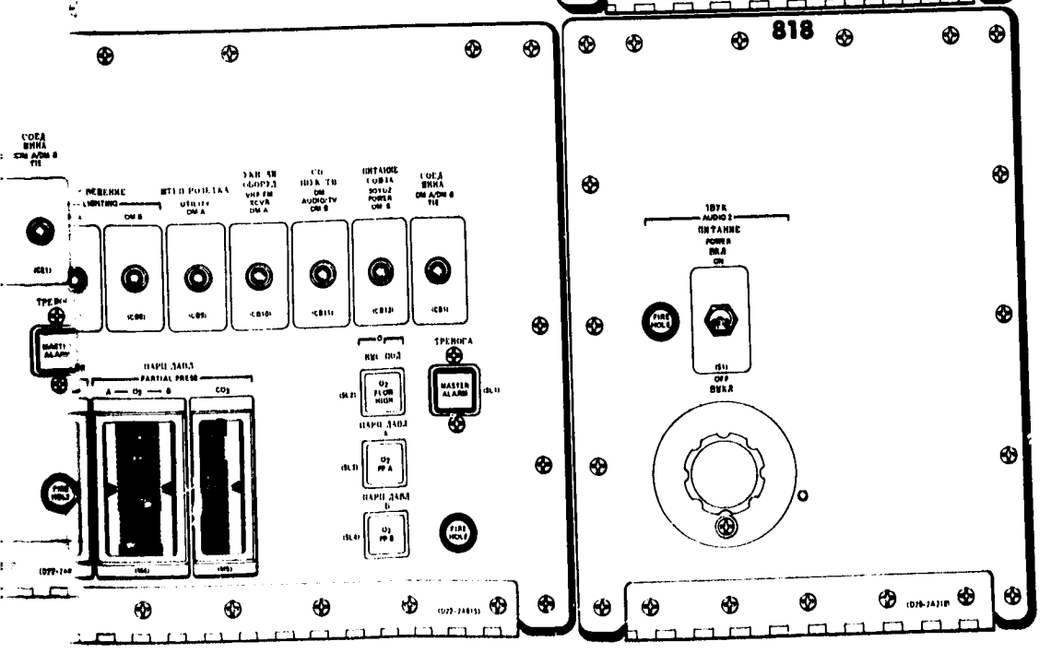

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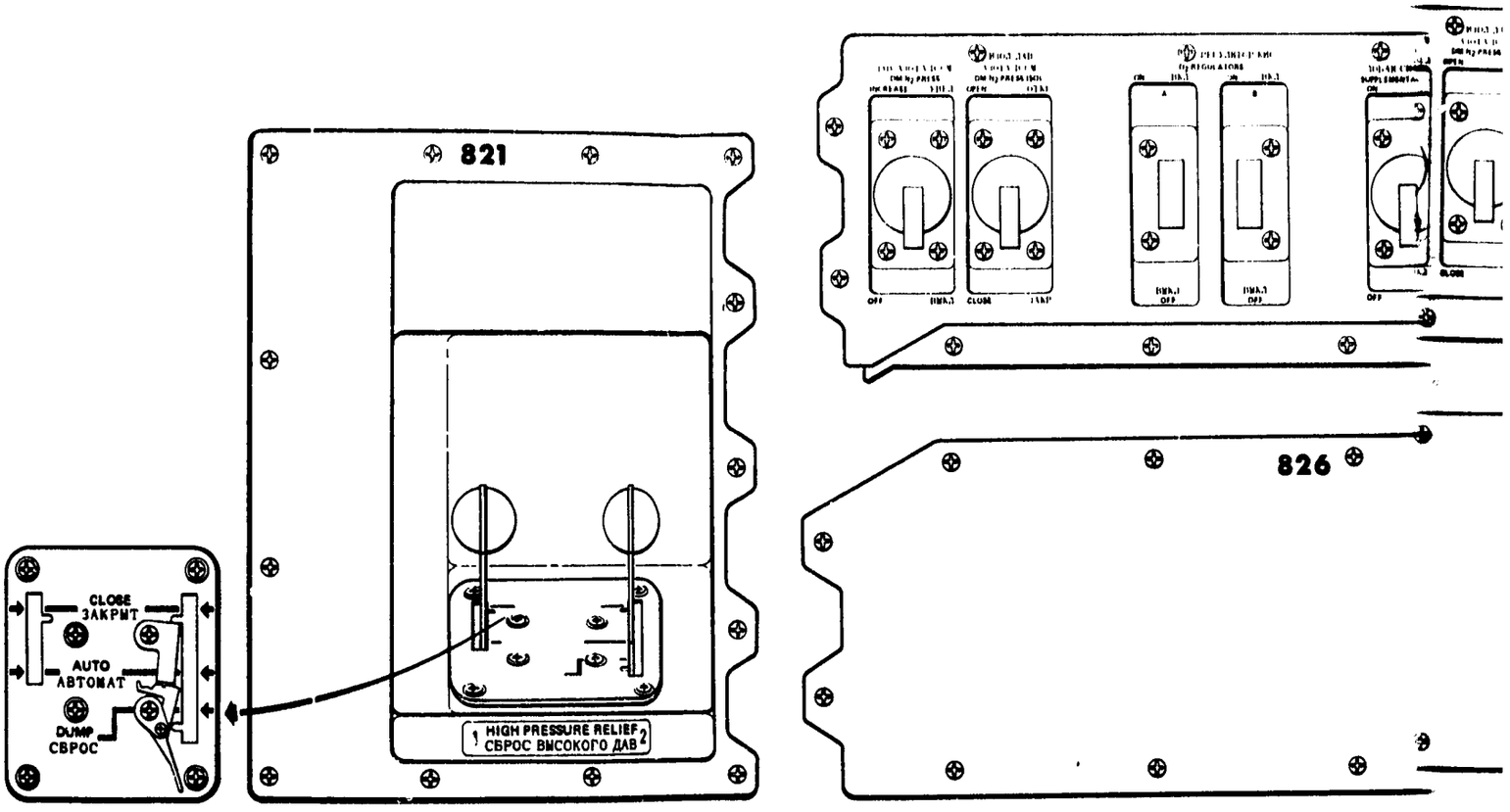
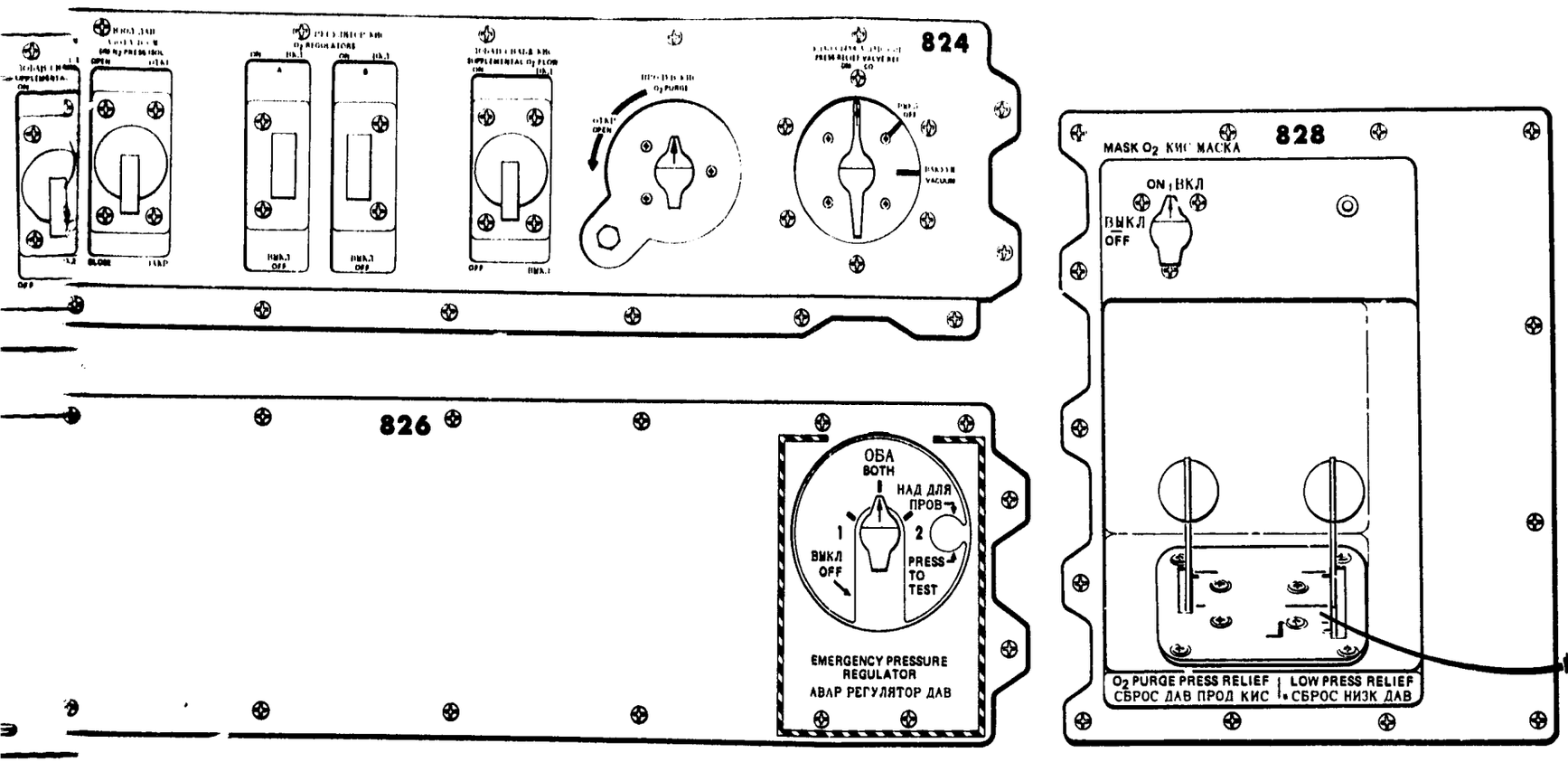
B-9/B-10


821
826
CLOSE
ЗАКРЫТ
AUTO
АВТОМАТ
DUMP
СБРОС
1 HIGH PRESSURE RELIEF
СБРОС ВЫСОКОГО ДАВ 2



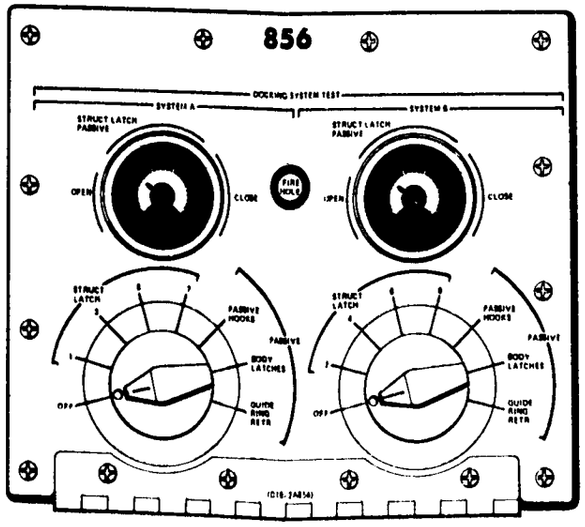
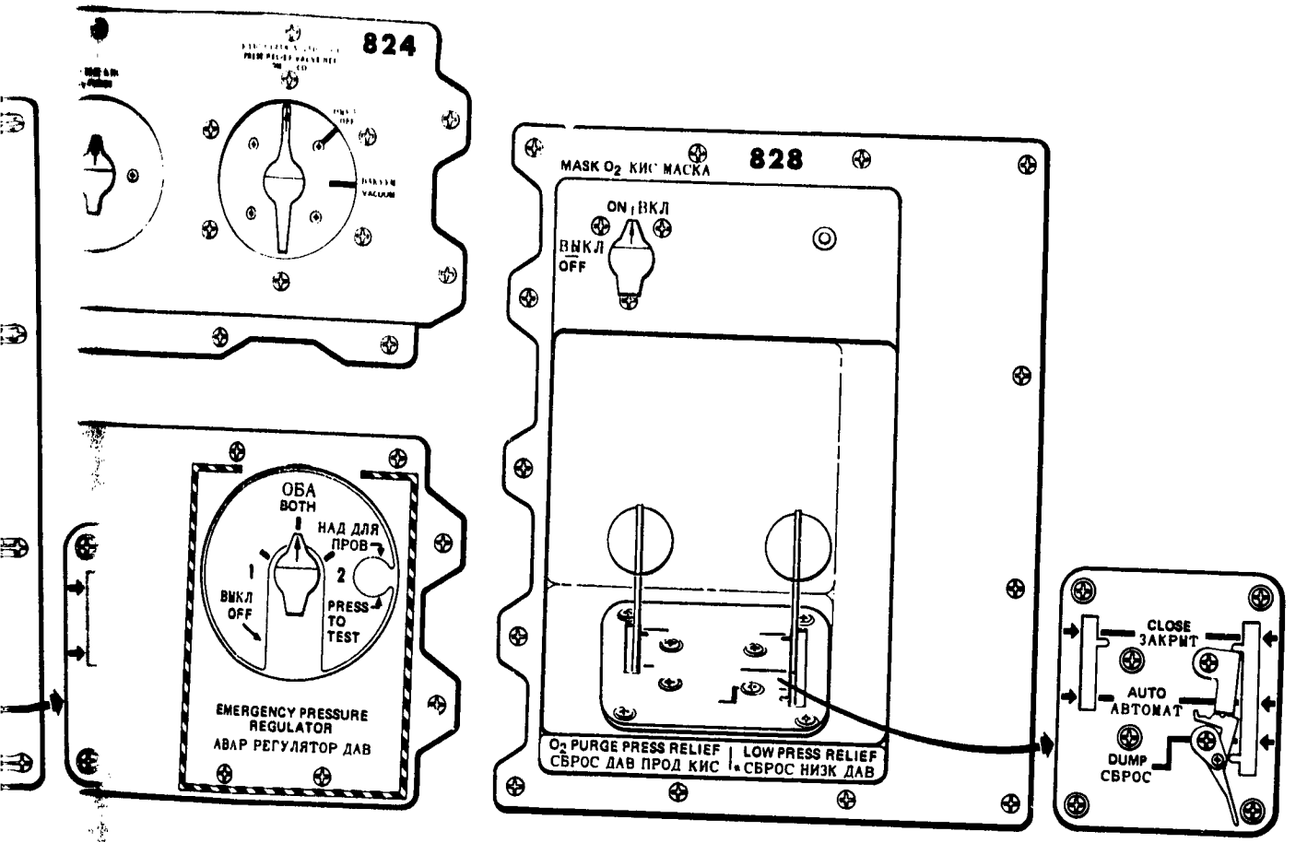


Figure B-1. DM Crew Displays and Controls (Sheet 2 of 3)

FOLDOUT FRAME



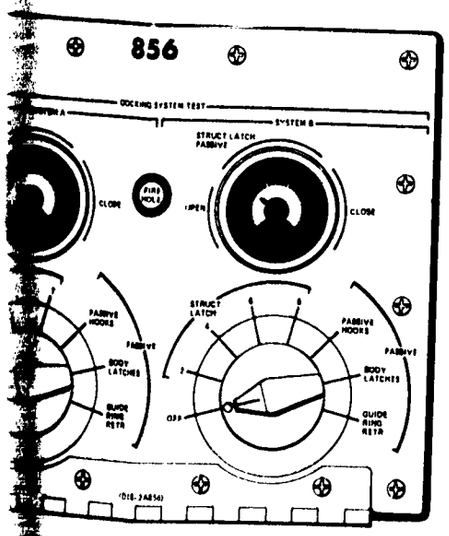
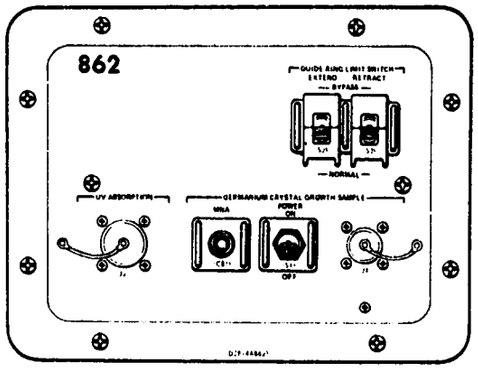
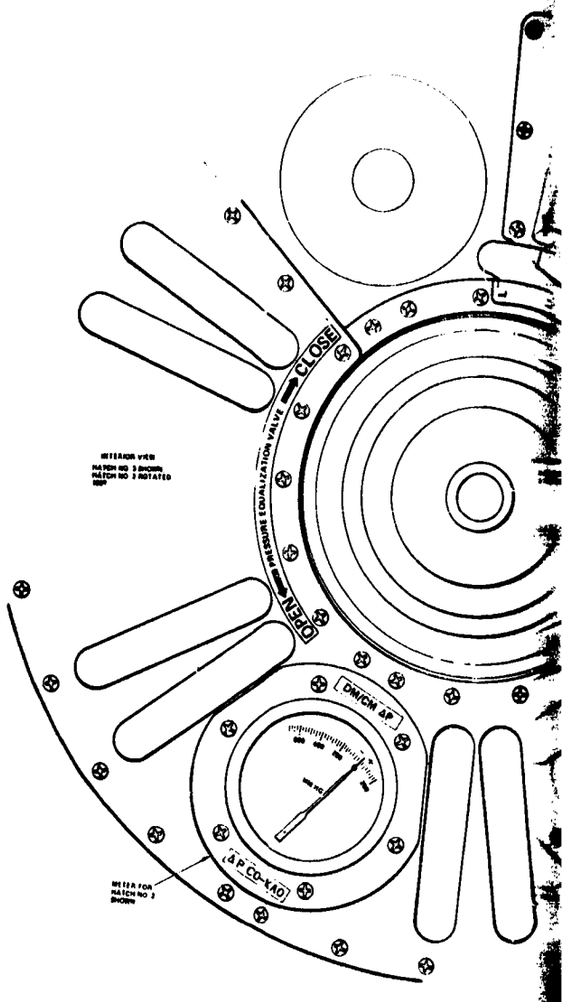
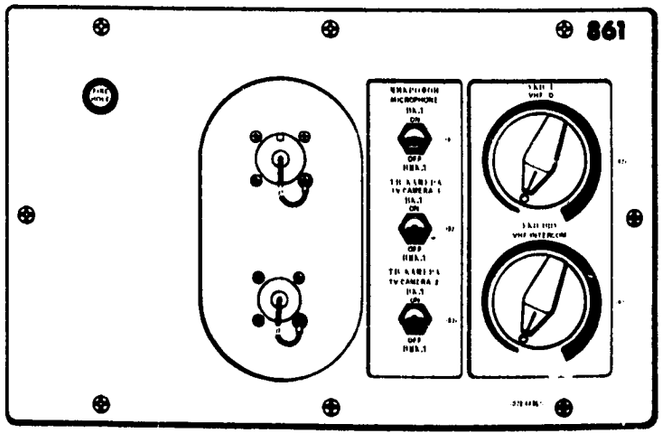
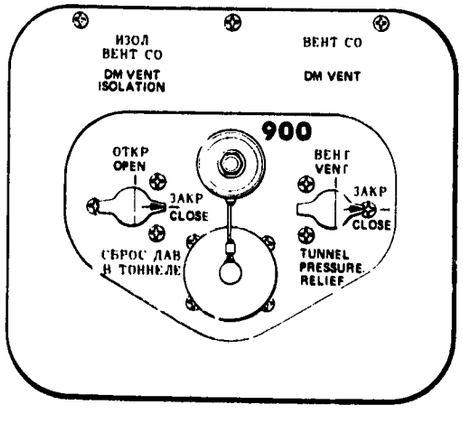


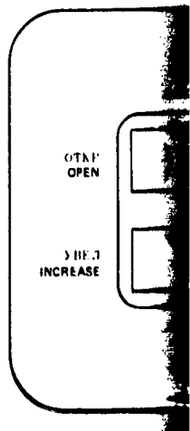
Figure B-1. DM Crew Displays and Controls (Sheet 2 of 3)


862
GUIDE RING LIMIT SWITCH
EXTEND
RETRACT
BYPASS
NORMAL
UV ABSORPTION
GERMANIUM CRYSTAL GROWTH SAMPLE
POWER
ON
OFF


CLOSE
OPEN
PRESSURE EQUALIZATION VALVE
DM/CM ΔP
(ΔP CO-HAO)

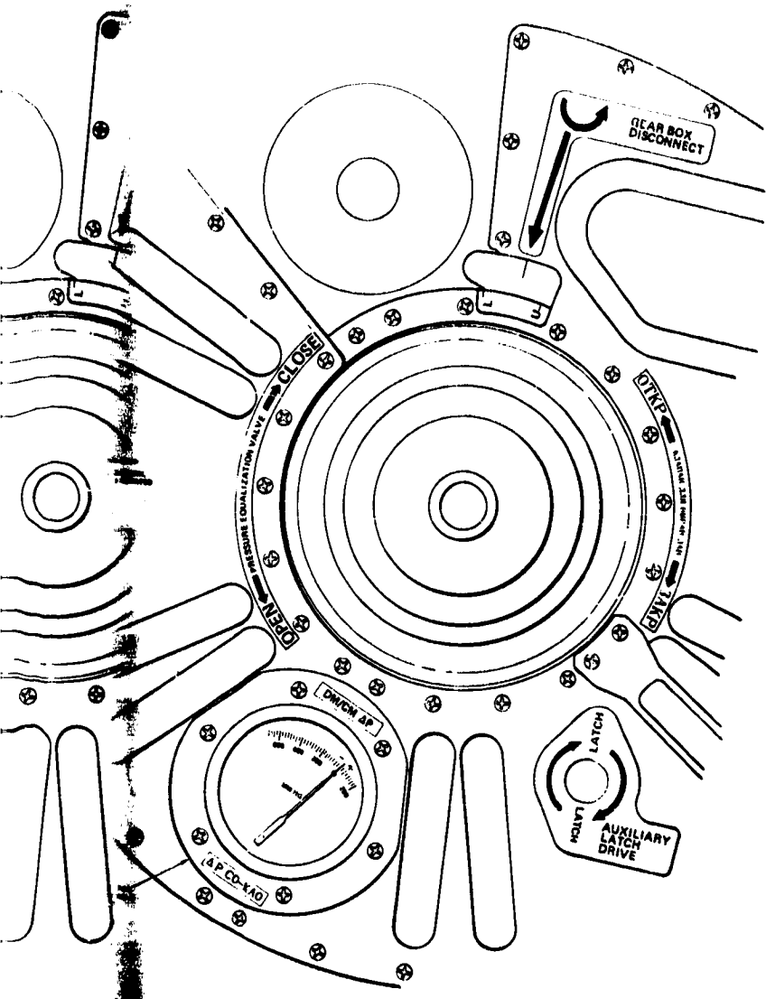

861
MICROPHONE
ON
OFF

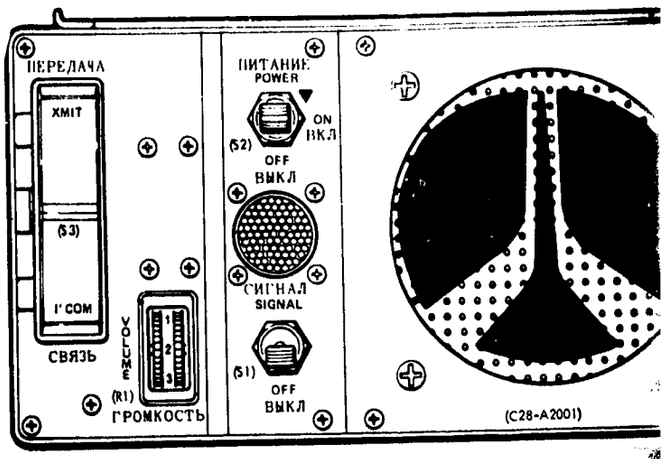

ИЗОЛ
ВЕНТ СО
DM VENT
ISOLATION
ВЕНТ СО
DM VENT
900
ОТКР
OPEN
ЗАКР
CLOSE
ВЕНТ
VENT
ЗАКР
CLOSE
СБРОС ДАВ
В ТОННЕЛЕ
TUNNEL
PRESSURE
RELIEF

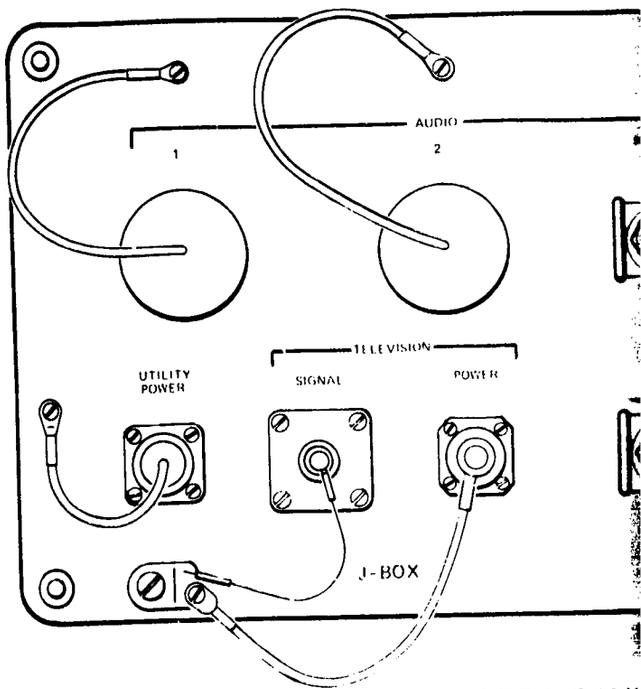

ОТКР
OPEN
INCREASE

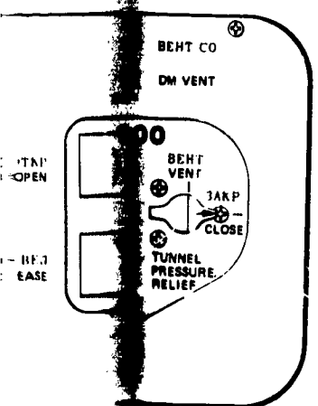
SOYUZ

960









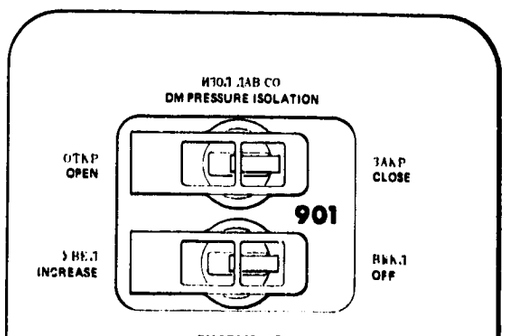
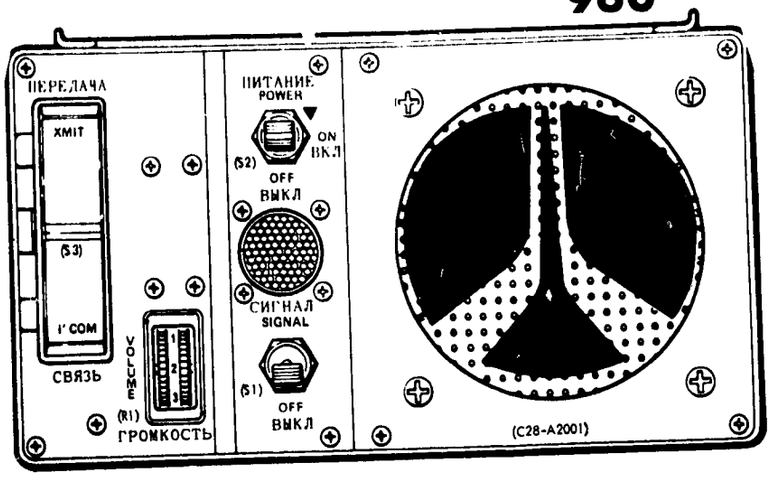


Figure B-1. DM Crew Displays and Controls (Sheet 3 of

SOYUZ

960



961

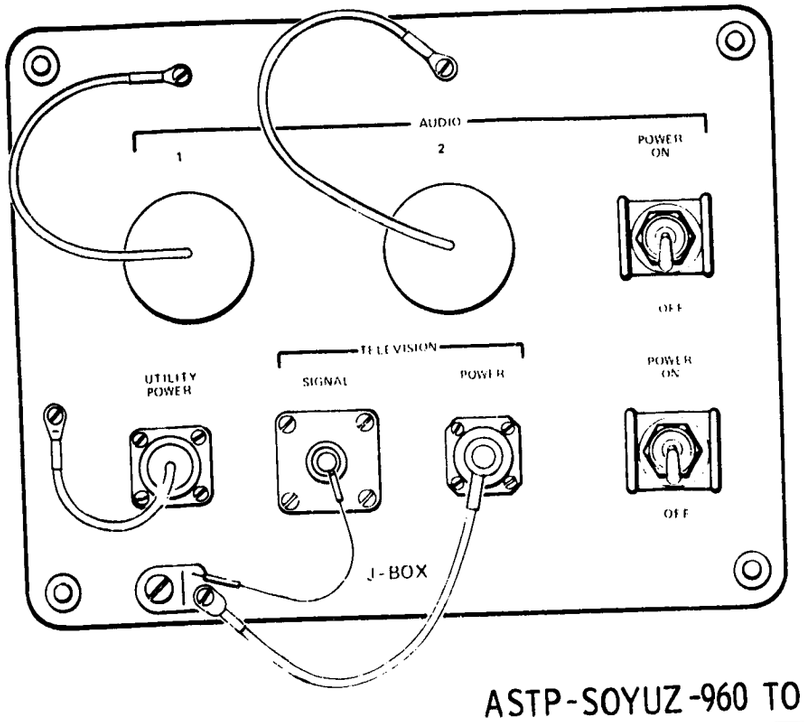


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Figure B-1. DM Crew Displays and Controls (Sheet 3 of 3)

FOLDOUT FRAME